

BYNESKRANSKOP 1
A LATE QUATERNARY LIVING SITE
IN THE SOUTHERN CAPE PROVINCE, SOUTH AFRICA

By

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(With 44 figures, 26 tables, and 1 appendix)

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ABSTRACT

The excavations at Byneskranskop represent the second phase in an investigation of the ecology of the prehistoric inhabitants of the Agulhas region of the southern Cape.

The excavations revealed a possibly unbroken occupation sequence spanning the last 12 500 years, from the terminal Pleistocene to the early years of white settlement of the sub-continent. They yielded quantities of artefactual and non-artefactual material that were in most cases adequate to document clearly the changes that took place during the occupation of the site.

As well as analysing the site data comprehensively, this report places an almost equal importance on comparisons with data from other sites in the Cape coastal region and its hinterland, since these are important for evaluating the chronology and nature of the changes revealed by the site data.

It was possible to divide the occupation sequence into four main phases and two intermediate ones, although the primary difference is between the content of the deposits younger than about 6 000 B.P. and those older. These phases can be related to 'Wilton', 'Albany' and 'Robberg' industries, but the analyses show that the differences are quantitative more than qualitative and that the changes in the various components of the excavated assemblage were diachronous rather than synchronous. The inter-site comparisons also indicate that the rate and nature of change were not consistent throughout the region during this period.

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INTRODUCTION

The Archaeology Department of the South African Museum has been engaged since 1969 in systematic research in the Agulhas region, the southernmost part of the African continent. The research programme commenced with excavations in a cave at Die Kelders in the Hermanus district, on the eastern shore of Walker Bay (Fig. 1). These excavations, which lasted until 1973, exposed a late Pleistocene (Middle Stone Age) sequence separated by a deep accumulation of archaeologically sterile sands from a relatively short late Holocene (Late Stone Age) sequence that spanned about the first five centuries of the present era.

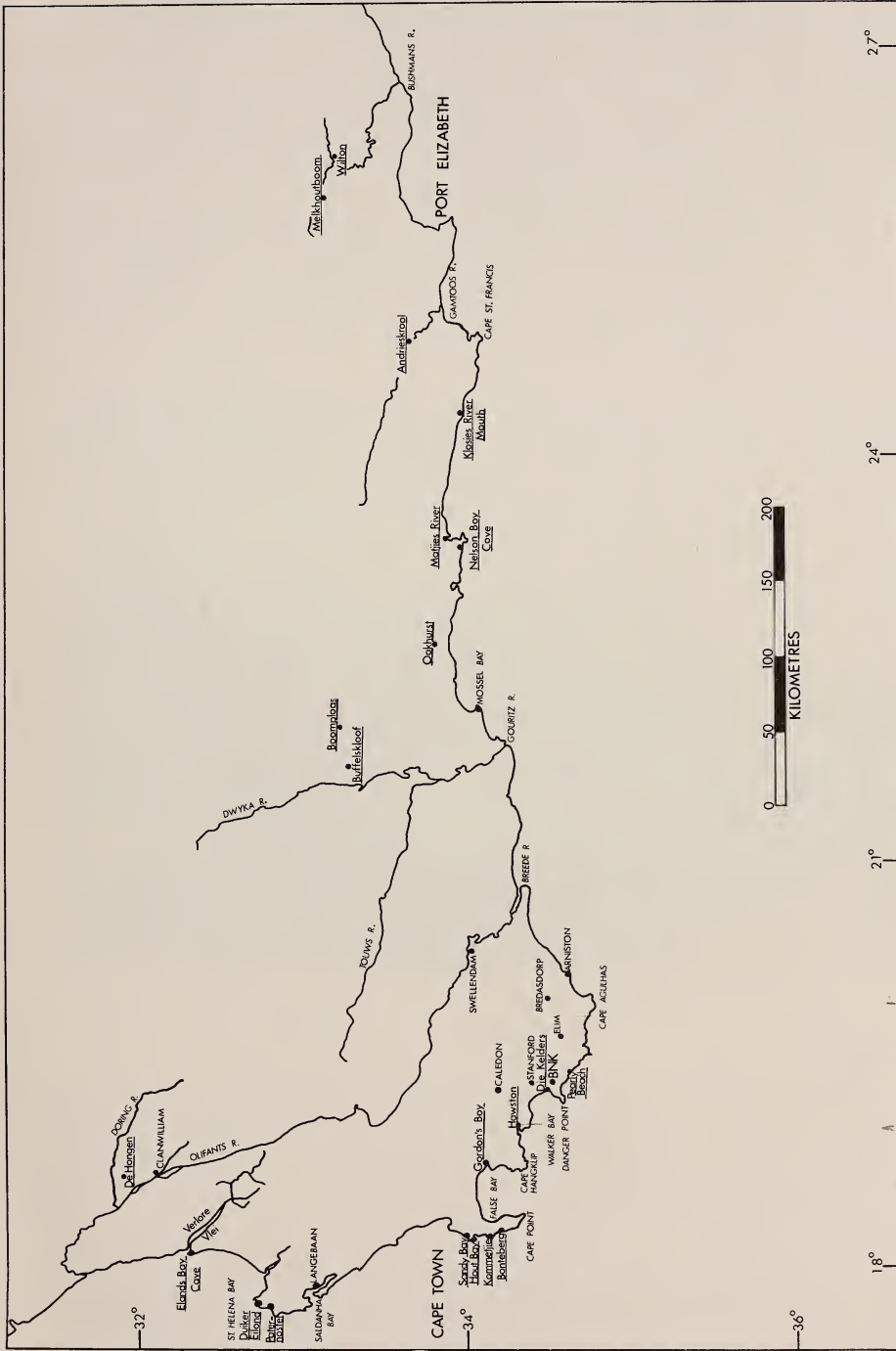


Fig. 1. Map of the southern Cape showing localities mentioned in the text. Archaeological sites are underlined except Byneskranskop, which is shown in bold type as BNK.

The Die Kelders excavations, of which only the Holocene sequence has as yet been published (Schweitzer 1979), were important not only because they yielded the then earliest dated evidence for the presence of pastoralists in southern Africa, but also because of the evidence they provided of a much earlier period of occupation. The deposits were, however, not entirely satisfactory in view of the great discontinuity between the two phases of occupation and the relative brevity of the Holocene occupation.

Complementary research in the area was meanwhile being carried out on a series of open sites by G. Avery (1976) of the Museum's Archaeological Data Recording Centre. Like the upper deposits at Die Kelders, these sites, located from Hawston to Pearly Beach (Fig. 1), were all somewhat ephemeral late Holocene accumulations.



Fig. 2. South-east aspect of Byneskranskop, showing the location of the main cave (1) and other sites.

Since this work had made the archaeology of the coast fairly well known, the next objective was to find a site in a different environmental zone, and preferably one that contained a sequence of deposits sufficient to provide a link between the M.S.A. sequence at Die Kelders and the L.S.A. occurrences at that site and along the coast.

This second phase of the research programme was begun in 1973 when a test excavation was carried out in a cave at Byneskranskop in the Bredasdorp district (Fig. 1), some 10 km south-east of Die Kelders and situated at the junction of the coastal plain and its hilly hinterland.

Interest in the site was stimulated by R. G. Klein, who had examined faunal material from 'Eyre's Cave' acquired in 1962 from the Medical School of the University of Cape Town and now housed in the collections of the Museum's Cenozoic Palaeontology Department (accession nos SAM-PQ1860-73). Included in the collection were the remains of two bovid species considered to have become extinct by the end of the Pleistocene, a giant buffalo, *Pelorovis* sp., and a giant alcelaphine, *Megalotragus* sp. (Klein 1974: 273). The presence of these animals suggested that a sequence of deposits might be found in the area that would provide the link between the two phases of occupation at Die Kelders.

The precise provenance of the material studied by Klein is not known, but is believed to have been the lowest cave in Byneskranskop. This had been cleared out for use as a cellar in unawareness of the palaeontological and archaeological potential of the deposit removed. Several human skeletons were also found during the clearance and this prompted an investigation of the cave near the top of the hill. Trenches were dug around the walls of the upper cave and, apparently, more human remains recovered. The fate of these remains is uncertain: some are known to have been re-buried in the grounds of the property below the cave, but cannot now be located. It was also subsequently learnt (P. Swart 1980 pers. comm.) that, several decades ago, deposits from caves at Byneskranskop were removed as 'guano', and that the local school-master had been in the habit of digging in the caves to augment the collection of skulls he used for teaching purposes.

It is the upper cave, designated Byneskranskop 1 (BNK 1), that is the subject of this report. The reference BNK 2 was given to a lower overhang, from the floor of which micromammalian remains were collected by D. M. Avery of the Museum's Archaeology Department as part of a comparative collection against which to study the microfauna from BNK 1, Die Kelders and other sites (D. M. Avery 1979). BNK 3 is the designation of a cave on the lower slope of the hill, in which excavations were carried out in 1979-80 in the hope that these would provide amplification of the somewhat scanty deposits of the final occupation phases of BNK 1, and which will provide the basis for a separate report. The location of the three sites is shown in Figure 2.

An initial examination of BNK 1 raised doubts as to the suitability of the site for archaeological investigation on account of the earlier, unauthorized, digging. Most of the area around the walls had been dug and much of the debris thrown towards the middle of the cave. Since an important consideration in any excavation was to try to establish a link with the coastal sites it was feared that the disturbance of the upper deposit might have made the site incapable of providing the requisite correlation. However, clearing of some of the surface debris in the centre of the cave indicated that the disturbance there was largely superficial, and when an auger sounding showed that the cave contained quite a considerable depth of deposit, it was decided to go ahead with a programme of excavation.

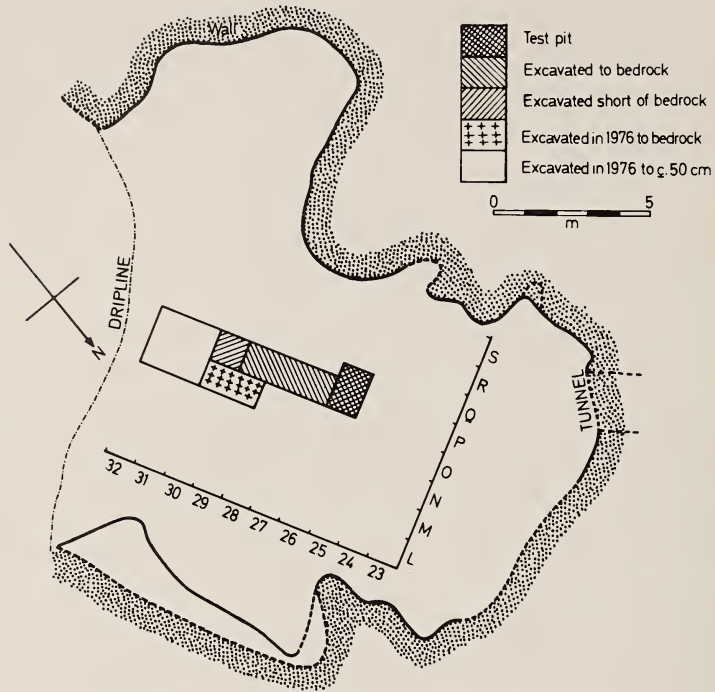


Fig. 3. BNK 1. Plan of the cave, showing the excavated area.

In March–April 1973 a test pit was excavated. The original area of the pit was 1×1 m but at a depth of about 0,7 m a human burial was partly exposed and it became necessary to enlarge the excavation to $1,0 \times 1,5$ m. Bedrock was reached at a depth of about 3 m, and laboratory examination of the material recovered indicated that a larger excavation was merited.

Because of a lack of clarity in the stratigraphy, partly explicable in the upper deposit as the result of disturbance due to the burial, much of the test pit was excavated in spits of varying thickness. The actual stratigraphy was made clearer by subsequent study of the walls of the test pit, but because of a lack of precise correlation between the spits and the actual stratigraphy, material from the test pit is not included in the analyses that follow.

In January–February 1974 a stratigraphically controlled excavation was undertaken, extending from the test pit towards the mouth of the cave. Three 1-metre squares were taken down to bedrock and a fourth excavated to about 90 cm short of bedrock.

After analysis of the material from the 1974 excavation, which formed the basis for a preliminary report (Schweitzer & Wilson 1978), it was decided to extend the excavation in order to increase the size of the samples, particularly the fauna. Accordingly, in November–December 1976 two 1-metre squares adjacent to the 1974 trench were excavated to bedrock and a further four in

front of the enlarged trench were excavated to a depth of about 50 cm in an attempt to resolve certain problems regarding the upper deposits.

The location of the excavation is shown in Figure 3. This also shows the irregular outline of the cave, which is about 19 m at its widest and 15 m long. At the back of the cave there is a debris-filled tunnel that, if cleared, would allow access to the hillside above the cave. A sink-hole at the end of the tunnel, visible from above, suggests that the cave originally had an inner chamber, as is the case at BNK 3. In the roof of the cave are three quite large solution cavities or 'chimneys' that open to the upper hillside. One of these is in the central area of the cave, approximately above grid square O 28.

THE SITE AND ITS ENVIRONMENT

Byneskranskop (34°35'S 19°28'E) is a limestone hill at the junction of the coastal plain and the hilly country that rises to the ranges of the Cape Folded Mountain Belt some 60 km to the north (Fig. 4).

BNK 1 is situated near the top of the hill, some 60 m above mean sea-level and at the top of a cliff that overlooks the valley of the Uilkraals River (Fig. 2). The general aspect of the cave is south-east but protection against the prevailing summer winds is afforded by a dense growth of *Sideroxylon inerme* trees



Fig. 4. Aerial view of Byneskranskop (centre), looking north. Beyond is the Swartkransberg, followed by the Kleinriviersberge, with the Riviersonderendberge just visible on the horizon.



Fig. 5. Topographic map of the area around Byneskranskop.

that rise from the slope below the cave and reach above the top of the cave mouth. The situation of the cave also affords protection from the rain-bearing north-westerly winds that blow during the winter months.

Since the environment in which the cave is situated is important in its relevance to the ecology of the cave's prehistoric inhabitants, its various aspects are discussed in some detail.

PHYSIOGRAPHY

As indicated in Figures 4 and 5, the Agulhas region consists of a fairly wide coastal plain separated by undulating hills from the ranges of the Cape Folded Mountain Belt. Outliers of these mountains reach to within a kilometre of the coast at the northern end of Walker Bay, but their main west-east spread is some 60 km north of the Agulhas region.

Topographically, the area around BNK may be divided into two main regions, the coastal plain and the hilly hinterland.

The coastal plain lies mostly below the 15,5 m (50 ft) contour line and in the vicinity of BNK is about 7 km wide. Spies *et al.* (1963: 5-6) consider the coastal plain to be an ancient marine terrace, standing about 6 m (20 ft) above mean sea-level at the coast and rising to about 46 m (150 ft.) at its inner margin which, in the vicinity of BNK, is a few hundred metres seaward of the Uilenkraal survey beacon at the top of the hill. Spies *et al.* (1963: 20-21) cite Du Toit (1954: 441, 464) as dating the terrace to the early upper Pleistocene, and this is probably relevant to the formation of the limestone dune ridges of which BNK is a part.

Much of the coastal plain between BNK and the sea consists of the valley of the Uilkraals River, but westwards towards Danger Point the hills run closer to the sea (Figs 2, 5).

The hills that lie between the coastal plain and the mountains are often called 'berge' (mountains) but rarely rise above 300 m above sea-level. In contrast, the mountains of the Cape Folded Belt in the Riviersonderend range to the north of BNK reach 1 465 m (Fig. 4). The highest point of the Franskraal se Berge, also known as the Duinfonteinberge, is only 381 m above sea-level (Figs 2, 5), and the highest point in the vicinity of BNK is the Swartkransberg, which rises to 515 m (Figs 4-5).

SEA-LEVEL CHANGES

Off-shore contours, showing depths of 10, 30 and 50 m below present mean sea-level, have been taken from the hydrographic survey map of the area drawn up by the South African Navy (Republic of South Africa: South Coast; Cape Hanglip to Cape Agulhas, 1970), and are shown in Figure 5.

On the basis of data contained in a paper on Cenozoic sea-level changes (Tankard 1975, fig. 2), it is possible to suggest that between 13 000-9 000 B.P. the sea-level was 50 m below the present, between 10 500-8 000 B.P. it was 30 m below, and between 7 000-6 000 B.P. it was 10 m below. The ranges of the

pairs of dates are not intended to indicate the periods during which the sea-level was at the depths mentioned but reflect a lack of concordance between the authors on whose work Tankard drew.

A 50 m drop in sea-level would add about 4–14 km to the width of the present coastal plain between Danger Point and Dyer Island, a 30 m drop about 1–7 km and a 10 m drop about 0,5–6,0 km (Fig. 5). The higher figure in each case covers the area around Dyer Island, which would be cut off from the mainland by a sea-level as little as 5 m below the present. The distance added to the mouth of the Uilkraals River, the closest point to BNK, would have been the lower figure in each of the pairs.

Although the wide ranges of the dates given for the –50 m and –30 m sea-levels indicate a need for caution in assumptions derived from these, it would seem that for most of its occupational history BNK has been 10 km or less from the sea. Consideration must, however, also be given to the possibility of a marine transgression such as that postulated for Langebaan Lagoon by Flemming (1977: iii, 81, 143–5). Flemming suggests that this transgression commenced at about 6 500 B.P. and reached a maximum of 3 m above present sea-level between 6 000–5 000 B.P., after which a regression continued until about 2 000 B.P., when the present sea-level was again reached.

Mörner (1978: 5–6) considers the period 10 000 to 6 000–5 000 B.P. as ‘the rising towards and the reaching of the Holocene “climatic optimum”’. It also corresponds to the postglacial sea-level rise and reaching of the highest Holocene sea-levels (some meters above the present) along most African coasts.’

In the absence of similar evidence for the Agulhas area and because of the lack of topographic data below the 15,5 m land contour for most of the coastal plain in the BNK area, the effects of such a transgression can only be speculated upon. Clearly, however, if such a transgression did commence at about 6 500 B.P. the sea-level at this time cannot have been at –10 m, as suggested by Tankard’s sources. If the sea-level at 6 500 B.P. was the same as at present it would also need to have been higher in the preceding period. The implication of Flemming’s and Mörner’s suggestions is that for perhaps the last seven to eight thousand years BNK has been less than 7 km from the sea, an important consideration in view of the evidence that marine resources became important to the occupants of BNK 1 only from about 6 000 B.P., as will be shown in a later section.

GEOLOGY

The geology of the area between Bredasdorp and Gansbaai has been studied by Spies *et al.* (1963). In the vicinity of BNK three main lithological units may be recognized. These are principally important for their effect on the vegetation they support, and secondarily as sources of some of the raw materials from which the stone artefacts were made that were recovered from the BNK 1 deposits.

The hills are formed of the quartzites and sandstones of the Table Mountain Group of the Cape Supergroup. Exceptions to these are the limestone ridges that flank the hills and are, lithologically, more properly part of the coastal plain.

The coastal plain consists mainly of the Tertiary to Recent consolidated or loose calcareous sands of the Bredasdorp Formation. These are mostly underlain by rocks of the Table Mountain Group which are generally exposed only along the shoreline and are in parts capped by calcified dune sands of marine and aeolian origin. The rock formed by calcification varies from crumbly calcareous sandstone to hard crystalline limestone.

Exceptionally, the valley of the Uilkraals River does not consist of calcareous dune-sands but of sands derived from the weathering of the rocks of the Table Mountain Group. These sands are, therefore, largely deficient in the lime that characterizes the sands of the coastal plain and are lithologically part of the hills unit.

The third lithological unit is the shales and sandy shales of the Bokkeveld Group of the Cape Supergroup. Although the Geological Survey map (Department of Mines 1963: 3419C, 3419D—Gansbaai) shows these as commencing about a kilometre east of BNK, roadworks at the northern end of the hill show that they extend at least as far as BNK, where they are shallowly overlain by sandy soil. Road cutting through the foot of the hill along the river valley has also exposed clays that are presumably derived from the weathering of these shales. They may, however, be fluvial deposits from the shale areas up-river.

The Bokkeveld shales extend eastwards for about 45 km in a band that ranges from about 2 km wide in the west to 17 km wide in the east. For the most part they are bordered on the north by the sheared shales and fine-grained graywackes of the Malmesbury Group. These shales weather to form clay soils that are variably mixed with quartzose sands.

DRAINAGE

The principal drainage of the BNK area is the Uilkraals River, which rises in the Perdeberg some 20 km to the north-east and has its mouth about 6,5 km south-west of BNK. The river is fed by three perennial tributaries, the Boesmans, Papies, and Baviaans rivers, but its flow is now evidently much reduced by the drawing off of water for agricultural and domestic purposes. For the most part the river's sluggish flow is accentuated by the low-lying terrain of the coastal plain, which gives rise to marshy areas that are flooded during periods of heavy rainfall. The river-banks, particularly between BNK and the sea, are now heavily infested by dense growths of exotic acacias (Figs 2, 4).

CLIMATE

Taylor (1961: 154–5) has described the climate of the area as 'equable', with temperatures rarely exceeding 33 °C in summer or falling below 1 °C in winter. Taylor gives the mean annual temperature recorded at Danger Point

Lighthouse as 16 °C with a mean variation ranging from 18,9 °C in January to 13,3 °C in July.

The area is considered to lie within the winter rainfall region, although during the years 1901–50 only 68 per cent of the mean annual rainfall of 543,8 mm recorded at Danger Point fell during the late autumn to spring months (May–October) (Taylor 1961: 154), and farmers in the area say that they receive rain throughout most of the year.

Additional moisture is provided by the sea mists that are not uncommon during the late summer, and is also collected by the summer south-east winds as they pass over the sea (Taylor 1961: 155); but the principal rainfall is contributed by the north-west winds that are most prevalent during the winter months.

Sunshine ranges from about 60 per cent of the possible duration in winter to over 70 per cent in summer (Schulze 1965: 314). It was noted, however, during the 1980 field season in the first fortnight of July, that the south-easterly aspect of the hill deprives it of sunshine for most of the day, and the caves were often unpleasantly cold and damp, even on sunny days.

VEGETATION

The natural vegetation of the area is the macchia-like growth known in South Africa as fynbos. Kruger (*in* Day *et al.* 1979: 2) describes the main physiographic features of the fynbos as a prevalent sclerophyllous shrub form, a scarcity of trees, and the relatively minor importance of grasses and evergreen shrubs.

Although more than a quarter of a century ago Acocks (1953: 129) pointed out that the fynbos on the limestone of the Bredasdorp district, and that of the Elim Flats, would have to be treated as separate veld types, no detailed floristic survey or analysis of these two areas has yet been undertaken. It follows, therefore, that general surveys of the fynbos are not wholly applicable to the BNK area.

An early outline survey of the vegetation of the Bredasdorp and Caledon districts was published by Jordaan (1946). Of this, the part (pp. 52–53) that deals with the strandveld or coastal plain is principally relevant to this report.

The climax vegetation is described as tall shrubs 3–5 m high, predominantly *Euclea racemosa* and *Pterocelastrus tricuspidatus*, with dwarf trees such as *Tarconanthus camphoratus* and *Sideroxylon inerme*, and an understorey of other small shrubs and herbaceous plants.

At places such as Platbos at Uilkraal, the locality of BNK, and Grootbos, a few kilometres to the north-west, remnant forest communities are found, which Jordaan considered to be floristically much the same as the fynbos of the coastal plain. The main difference is that what are shrubs on the coastal plain are found in the forests as trees up to 12 m tall.

The ecology of these forests has been studied by Taylor (1961), who reports (p. 154) that the geology of the forest areas consists mostly of Table

Mountain Sandstone except in the Tall Forest (Grootbos), where part grows on granite, and in parts of the Short Forest (Platbos), where the Table Mountain Sandstone is overlain by sandy limestone characteristic of the coastal plain. Taylor (1961: 159–162) describes the Short Forest as essentially dominated by *Calvaria inermis* (= *Sideroxylon inerme*) and *Euclea racemosa*, while the Tall Forest is dominated by *Celtis rhamnifolia* (= *C. africana*), *Olinia cymosa* and *Apodytes dimidiata*. An outlier of the Short Forest covers much of the cliff face at BNK, as indicated in Figure 2. The trees on the lower slopes and in the foreground, across the river, are predominantly *Sideroxylon inerme* but the vegetation of the river valley, where not cleared for agriculture, now consists mainly of Australian acacias (*A. cyclops*, *A. saligna*, and *A. mearnsii*) and the European poplar (*Populus* sp.).

Jordaan (1946: 52) observed that the climax vegetation of the limestone dunes differs floristically from that of the sandy soil, with Proteaceae predominant and *Rhus* spp. and reeds, notably *Chondropetalum tectorum*, more prevalent than on the coastal plain. He also pointed out that in the area where the calcareous soils or limestone dunes have their greatest extent, between Cape Agulhas and the Potberg, i.e. to the north-east of Cape Agulhas, parts are ploughed for grain cultivation. J. Rourke (1980 pers. comm.) has also mentioned that the calcareous to neutral soils of the Bredasdorp district have enabled the westward migration of sub-tropical genera such as *Carissa*, *Cussonia*, *Scadoxys*, and *Sideroxylon*.

The climax vegetation of the clay soils around Elim is, according to Jordaan (1946: 53), a fynbos mosaic in which, like that of the limestone areas, Proteaceae predominate. Since the clay soils are good for grain cultivation the climax vegetation is, however, seldom found today.

Another veld type mentioned by Jordaan (1946: 50) occurs on the hills to the north of BNK (Fig. 4). This is locally known as 'heiveld' (heathland) and is dominated by reeds, although Jordaan observed that it is also a mosaic vegetation, which he considered resulted from the destruction of the shrubs of the fynbos, which will regenerate if the land is left undisturbed. Jordaan reported that farmers say that 'heiveld' is not suitable for grazing—it is said to be 'sour veld'—except where soft reeds predominate.

Acocks (1975: 87) considered that the climax vegetation of the coastal fynbos is 'a grassy, more or less open scrub, at least on the south coast belt and on the Cape Flats'. Elsewhere, Acocks (1979: 681) divided the vegetation of the 'coastal plateau' into two types, Renosterbosveld, dominated by *Elytropappus rhinocerotis* on clay soils (cf. Acocks 1975: 86) and fynbos on sandy soils in part overlying 'calcareous tufa'. He suggested that a short closed forest may have covered 'all of the more or less sand-covered limestone ridges of the Duineveld of Bredasdorp' and areas to the east; that 'this sort of short forest rotated with tall Protea fynbos and Themeda-dominated grassveld'; and that 'the grassveld phase may have been shorter-lived than in the Renosterbosveld'.

Taylor (1978: 204) also has two major subdivisions of the coastal fynbos, but these are geographically greater than those of Acocks mentioned above. Taylor's divisions are one on marine sands north of Cape Town and the other 'on limestone east of Danger Point to near Mossel Bay'. He considers that the difference in the two vegetation types is more floristic than physiognomic, and that both are 'typical fynbos with restioid, ericoid and some proteoid forms, but both have many more grass species and annuals than Mountain Fynbos'.

In contrast to the views of Acocks and Taylor, quoted above, that the coastal fynbos can be described as grassy, are the observations of Spies *et al.* (1963: 8), relevant to the research area, that perennial grasses are few and consist mainly of lank, sour grass types that grow on the Table Mountain Sandstone, but that during the winter months there is an abundance of annual grasses. J. Rourke (1980 pers. comm.) has pointed out that the acid soils derived from Table Mountain Sandstone are inimical to the development of grasslands, and C. Boucher (1980 pers. comm.) has mentioned that many of the grass species now present in the fynbos are probably not indigenous. It has already been mentioned that the shale and clay soils to the north and east of the BNK area are good grain-lands and therefore good grasslands, and it should be pointed out that grain cultivation is a winter occupation in this area.

That grass can, and does, grow in the BNK area is not disputed. Local farmers are able to maintain small herds of sheep and cattle on a year-round basis, although these animals are not entirely dependent on grasses. It seems unlikely, however, that the geology of the area would have permitted the development of extensive grasslands on the coastal plain. As anyone who has travelled in the area will know, the main areas of grain cultivation are away from the coastal plain, and it seems reasonable to assume that in a region in which the cultivation of grain is a primary agricultural industry, land suitable for such a purpose would not be neglected.

The availability of adequate grazing as well as the overall nature of the vegetation are important considerations in the light of the changes that took place in the composition of the fauna represented in the BNK 1 deposits, and which are discussed in a later section. Van Zinderen Bakker (1976: 181) has suggested that 'from a plant ecological view it seems more likely that the evolution from open grassland to closed vegetation was caused by climatic rather than sea-level changes'. This evolution was postulated for the Nelson Bay Cave area by Klein (1972a, 1974), and also forms part of Acocks' 'rotating vegetational pattern' for the 'coastal plateau', as mentioned above; but an *a priori* requirement for the development of grasslands, whatever the climatic conditions, is the presence of suitable soils.

FAUNA

The terrestrial fauna of the area, especially when compared with the remains of the animals recovered from the BNK 1 deposits, is nowadays severely depleted. The smaller antelope such as grysbok (*Raphicerus melano-*

tis), steenbok (*R. campestris*), and klipspringer (*Oreotragus oreotragus*) are still to be found in the more undisturbed parts. Hares (*Leporidae*), porcupines (*Hystrix africae-australis*) and some of the smaller carnivores, e.g. ratel and otter (*Mustelidae*), genet and mongoose (*Viverridae*), and wild cat (*Felis libyca*), are also still to be found, as are tortoises (*Chersina angulata* and *Pelomedusa subrufa*) and a number of species of snake. The bontebok (*Damaliscus dorcas*) is now preserved in the Bontebok National Park, about 110 km north-east of BNK, which is also the refuge for a number of other antelope that previously ranged free in the area.

Marine resources, both of the shoreline and the deeper waters, are also much depleted although most kinds of shellfish are still relatively common in some areas and the coastline still offers reasonable sport for anglers. Choice seafoods such as the rock lobster (*Jasus lalandii*) and the perlemoen (*Haliotis midae*) are, however, rarely to be found, even by skin-divers; and the local trawling industry that operates out of Gansbaai and Hermanus has been severely depressed for a number of years as a result of excessive competition. Southern right whales (*Eubalaena australis*) are to be seen in Walker Bay during the breeding and calving seasons.

SUMMARY

As will be evident from the foregoing, BNK 1 is well situated, in a climate free from harsh extremes, close to permanent running water, at the junction of two major environmental zones and not too distant from a third, the sea. Access to the interior would have been facilitated by the cutting of the Uilkraals River valley through the hills behind the coastal plain, and the relative flatness of the plain would likewise provide few obstacles to travel. Except in occasional instances of flooding, the river would not hinder movement across the coastal plain.

A somewhat extensive examination of the published data on the vegetation of the area has been provided, together with the differing views of various researchers, since it is ultimately the vegetation of an area that determines the suitability of that area for the existence of various life forms. It is of some relevance to the human ecology of the area that among the flora of the remnant forests listed by Taylor (1961) are at least twenty species known or said to be of value as food or medicine (cf. Smith 1966), and local informants are able to add to that number.

Although the local fauna, both terrestrial and marine, is nowadays much reduced by comparison with what has been revealed by the faunal sample from BNK 1 to have been present in the area in the past, it provides parameters against which the effects of human activity and climatic change can be gauged.

THE EXCAVATIONS

EXCAVATION PROCEDURE

Excavation was carried out by the usual method of trowel and brush. Excavated material was sieved at the site through a double rack of sieves, one of 12,7 mm ($\frac{1}{2}$ in.) mesh above one of 3,2 mm ($\frac{1}{8}$ in.) mesh. Separate spoil heaps were used for the 1973-4 and 1976 excavations, and these were located beyond the drip-line.

Preliminary sorting into raw material categories of stone, bone, and shell was carried out at the site and the sorted material packed in bags marked with the site reference, date, grid and stratigraphic references, and the raw material category.

Carbon samples for radiocarbon dating purposes were removed directly from the deposit, using a trowel or tweezers, and stored in labelled polythene bags. During the 1974 excavation soil samples were also taken from the deposit for palynological analysis, should this become practicable.

A daily site log was maintained in which records were kept of the squares and stratigraphic units excavated and the number of buckets of deposit removed. Observations regarding the nature of the deposit were also recorded, and drawings made of the stratigraphic and other features such as the human burial, hearths, and variations of the stratigraphy within grid squares. Although much of the data recorded in the site logs is not included in this report, they have formed the basis for the information provided. These site logs, one for the 1973-4 excavations and another for the 1976, are retained in the Archaeological Data Recording Centre of the South African Museum.

In 1978, after it was decided not to extend the excavation further, the walls of the main trench were protected by hoardings of treated wood, the walls first having been lined with heavy polythene sheeting. The shallow excavation in the front four squares was also lined with sheeting before being back-filled.

Prior to the securing of the walls of the excavation, rain coming through the central 'chimney' during an exceptionally heavy storm caused the collapse of part of the upper deposit in grid square O 28. Corrugated iron sheets placed at the edge of the excavation, under the 'chimney', now protect this from further similar damage.

STRATIGRAPHY

The cave deposit consists mainly of fine, grey or brown soils of which the stratigraphy is generally poorly defined. There was a certain amount of penetration of the deposit by roots of the *Sideroxylon inerme* trees that front the cave, but never enough to hamper the excavation or disturb the deposit. The floor of the cave dips towards the mouth, and there is a large depression in the north-east part of the cave, possibly the result of scouring out of the deposit by rain-water, or else of digging for 'guano'.

In the 1973 test excavation of grid square P 26 and half of Q 26, a total of seventeen spits was excavated, bedrock being reached at a depth of 2,93–3,03 m below the surface. A human burial was encountered in Spit 6 of square P 26, necessitating the extension of the test pit into square Q 26. The presence of the burial obviously invalidated the stratigraphy of some of the overlying deposit, but this was later determinable from the sections of deposit exposed by the excavation.

In the 1974 excavation grid squares P 27–29 were excavated to bedrock, and P 30 to some 90 cm short of bedrock. A tendency for the overburden from the unauthorized diggings to fall into the trench necessitated the cutting back of a shelf in squares Q 29–30.

In the 1976 excavation squares O 29–30 were excavated to bedrock and squares O–P 31–32 to a depth of about 50 cm.

In the 1974 excavation sixty-three individual stratigraphic units or features were excavated, and sixty-one in 1976. Many of these were localized features such as hearths or patches of differently coloured or textured soil that did not extend over the whole of the excavated area or perhaps even a whole grid square. Others were small lenses or somewhat arbitrary subdivisions of larger stratigraphic units made to ensure precise stratigraphic control. After examination of the stratigraphy of the unexcavated deposit and laboratory analysis of the material recovered, it was decided to combine the stratigraphic units into twenty major units, here termed 'layers'. The stratigraphy of these layers, taken from the O–N line in squares 29–30, is indicated in Figure 6.

Layer +

This was a surficial deposit of fine, reddish-brown sandy soil that was considered to be disturbed and possibly contaminated by debris from the unauthorized diggings. A layer of leaf-mould approximately 2 cm thick was considered to mark the base of this layer. Material recovered from this layer has been retained but is not included in the analyses. The volume of material excavated from layer + was not calculated.

Layer 1

The sand of the surficial deposits continues into this layer, where it becomes more brown. In the front four squares, from which the overburden from the unauthorized diggings was removed to a level approximately equal to that of the rest of the surface, the deposit was considered to be undisturbed. The middle sub-unit was distinguished by compacted ashy patches, and the basal sub-unit was again a fine, brown sand. The volume excavated was calculated as 2,6 m³.

Layer 2

The two sub-units of this layer are a sandy soil that is more grey than brown, and a dark, humic soil. The volume excavated was calculated as 0,57 m³.

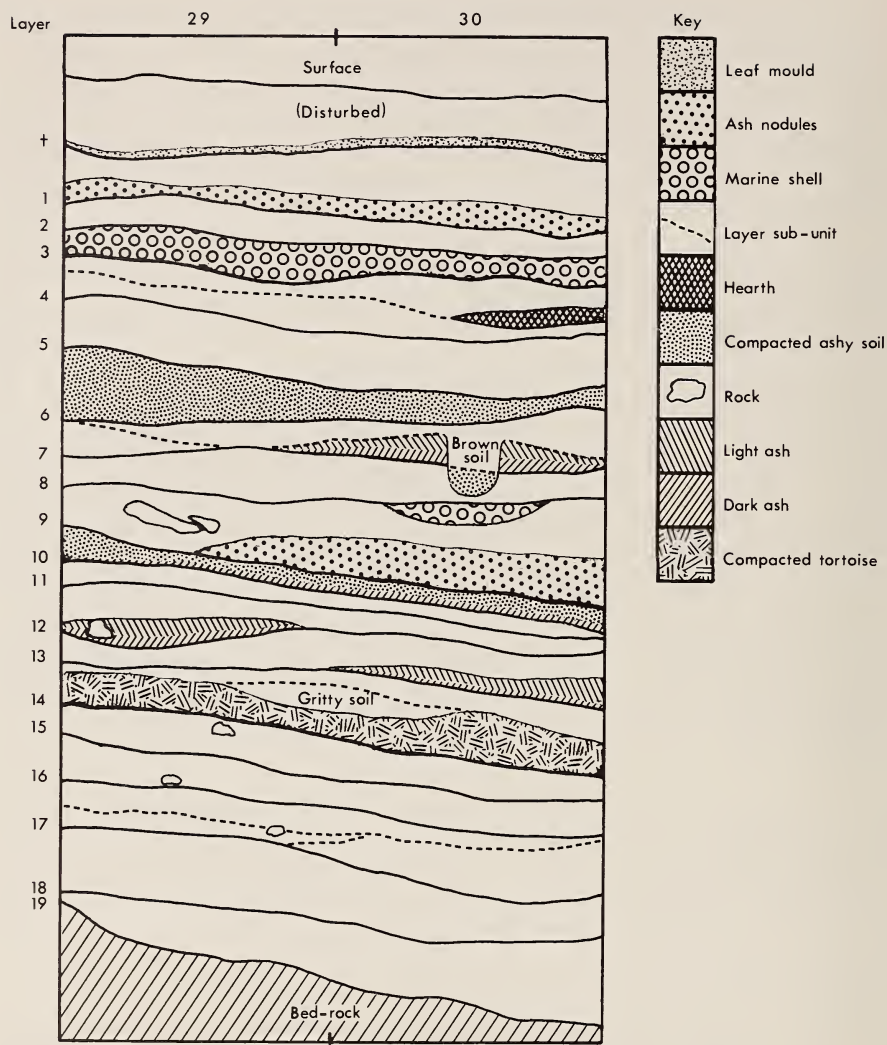


Fig. 6. Stratigraphy of the main layers in grid squares 29 and 30, on the O-N line. Each square is 1 m wide.

Layer 3

This is distinguished from the adjacent layers by a high density of marine shell. Although it was not consistent over the whole of the excavated area, the density of shell in this layer almost qualifies it to be called a shell-midden deposit. Layer 3 was not recognized in squares P 27-28 and may thus be a localized feature. The volume excavated was calculated as 0,25 m³.

Layer 4

The two sub-units in this layer are a fine, brown sandy soil of which the base is marked by what appears to be a thin band of calcined shell. The layer was characterized by a number of hearths in squares P 28–30, and in square P 29 a patch of decayed vegetation was considered to be an area of bedding. The excavated volume was calculated as 0,91 m³.

Layer 5

The number of sub-units in this layer varied from one to five in different parts of the excavation. The layer as a whole was characterized by a relatively high density of artefactual and faunal material in a greyish soil matrix. The excavated volume was calculated as 1,24 m³.

Layer 6

This layer was distinguished by its high ash content, and included several hearths. The excavated volume was calculated as 0,84 m³.

Layer 7

In places it was difficult to determine the base of layer 6, but on the whole layer 7 was less compacted and less ashy than layer 6, although it also contained a number of hearths. The excavated volume was calculated as 0,81 m³.

Layer 8

This layer was not recognized in squares P 27–28, and in the other squares its base was determined by the presence of a fine, grey ash band. The excavated volume was calculated as 0,58 m³.

Layer 9

The upper sub-unit of this layer consisted of a dark-brown, gritty soil that was mainly damp and appeared to contain relatively high frequencies of microfauna and roof spalls. Although this sub-unit suggests a period of sparse or no occupation, the relatively high artefactual and faunal content of the layer as a whole suggests that occupation of the site during the period of deposition of the lower sub-unit may have been fairly intensive. The two radiocarbon dates for this layer (Table 1) do not indicate a hiatus. Part of the lower sub-unit is characterized by numerous ash nodules. The excavated volume was calculated as 1,02 m³.

Layer 10

This is a compacted, ashy layer, yellow in parts and underlain by a black, carbonized deposit. The excavated volume was calculated as 0,56 m³.

Layer 11

This small layer was the in-fill between the carbonized deposit of the lower part of layer 10 and an ash band, of which the base was taken to mark the top of layer 12. The excavated volume was calculated as 0,28 m³.

Layer 12

Another compacted, carbonized deposit, easily recognizable, with poor bone preservation in parts. The excavated volume was calculated as 0,56 m³.

Layer 13

This layer may be a facies of layer 12 as it contained much the same sort of ashy or carbonized soil and was not clearly distinguishable from the overlying deposit. Square P 30 was not excavated below this level. The excavated volume was calculated as 0,45 m³.

Layer 14

The upper part of this layer consists of a brownish soil in which, towards the front of the trench, in squares O-P 29-30 a lens of gritty soil occurs. The layer was remarkable for the dense concentration of tortoise remains that comprise the basal deposit. This 'tortoise midden' is evidently a lens that begins to thin out towards the front of the cave. The excavated volume was calculated as 0,77 m³.

Layer 15

A loose brown soil without much material content, separated in places from layer 16 by a band of darker soil. The excavated volume was calculated as 0,60 m³.

Layer 16

The soft sandy soil of this layer, brown in parts, grey in others, was not always readily distinguishable from layers 15 and 17. Towards its base it contained more stone and bone than the overlying soil. The excavated volume was calculated as 0,62 m³.

Layer 17

A brown, sandy soil, distinguished from layer 18 by the presence of ashy flecks or nodules. The volume excavated was calculated as 0,57 m³.

Layer 18

A light-brown soil with ashy patches. It was not always distinguishable from parts of layer 19. The excavated volume was calculated as 0,65 m³.

Layer 19

The basal deposit is made up of a number of often poorly defined lenses with varying characteristics, which overlie the bedrock and fill in the irregularities of its surface. In 1974 four sub-units were recognized, but in 1976 only two. The excavated volume was calculated as 0,98 m³.

As mentioned, the stratigraphy was seldom clearly defined and, as was to be expected, the various strata were not evenly distributed over the whole of the excavated area. The only clearly definable units were the shell band of layer 3 and the concentration of tortoise remains in layer 14. Layer 6 was generally more ashy than the other layers, but the presence of ash features, many of them assumed to have been hearths, was characteristic of layers 4-9.

It is arguable that some of the smaller layers should have been combined, and it is possible that some of the sub-units that have been combined should have been kept separate. The poor stratigraphy also allows the possibility that material from adjacent layers might have been incorrectly assigned in some of the squares. The presence of seed cases of probably recent date, as far down as layer 15 and ascribable to rodent activity (see section on plant remains), represents another factor that cannot be ignored. However, since there was no clear evidence of major disturbance of the deposits in the excavated area apart from the surface deposits and the human burial in the test pit, the amount of mixing of material is not likely to have been great. In the analyses of the excavated material that follow it has accordingly been assumed that the material has been recovered from its proper stratigraphic context. The analyses indicate reasonable consistency within the layers, and this tends to support the general correctness of the excavation procedure.

DATING AND CORRELATION

A total of twelve radiocarbon dates was obtained, which show the site to have been occupied over a period of some 12 500 years. These dates are listed in Table 1. Those with the reference Pta- were provided by the Natural Isotopes Division of the Council for Scientific and Industrial Research, Pretoria. The second date for layer 9 was obtained by courtesy of R. G. Klein from the radiocarbon laboratory of the University of Washington (ref. UW-), and the date for the basal deposit was determined by Teledyne Isotopes, Westwood, New Jersey (ref. I-).

The span of some 3 000 years covered by the four dates for layer 1, obtained from carbon samples taken from some 35 cm of deposit, suggests a much lower rate of deposition than that, for example, of layers 12-9. Here, disregarding compaction, some 50-60 cm of deposit accumulated in a period of about 1 400 years.

The youngest date for layer 1 does not mark the final occupation of the cave but is associated with the only find of metal at the site, a small copper or brass bead that came from the second of the sub-units of this layer that were considered stratigraphically reliable. The second date for layer 1 was obtained

TABLE 1
Radiocarbon dates (uncorrected) for occupation layers.

Layer	Lab. no.	Years B.P.
1 (upper—O 31,1b)	Pta-1864	255 ± 50
(upper—P 32,1b)	Pta-1866	535 ± 50
(middle—CLA)	Pta-1865	1 880 ± 50
(bottom—EVA)	Pta-1631	3 220 ± 45
2	Pta-1569	3 400 ± 55
5	Pta-1571	3 900 ± 60
9 (upper—MOR)	Pta-1772	6 370 ± 90
(lower—NEL)	UW-409	6 100 ± 140
10	Pta-1905	6 540 ± 55
12	Pta-2347	7 750 ± 90
14	Pta-1587	9 760 ± 85
19	I-7948	12 730 ± 185

Note. All dates are based on the Libby half-life of $5\,568 \pm 30$ years.

from charcoal directly associated with potsherds in the same sub-unit as the metal bead but a different square. The minimum difference of 180 years between these two dates may indicate that layer 1 was more disturbed than was appreciated during the excavations, or it may simply attest to the sporadic nature of the occupation of the cave during this period.

The third date for layer 1 records the earliest occurrence of potsherds at the site. About half a dozen were recovered from the lowest sub-unit but these are considered to have been trampled in from the upper sub-unit. Klein's unpublished preliminary analysis of the mammalian fauna from the 1974 excavation shows that sheep remains were also found in the lowest sub-unit, but it seems likely that Pta-1865 should also relate to the earliest occurrence of domestic sheep in the BNK 1 deposits.

The oldest date for layer 1 is some 1 300 years older than the date for the overlying sub-unit (CLA), and closer to that for layer 2. This suggests that the basal sub-unit (EVA) and layer 2 should have been combined.

The dates for layers 2 and 5, relative to the depth of deposit, support the suggestion of a lower rate of deposition for layer 1. They also pose problems regarding the chronology of layers 6–8, again with regard to depth of deposit as an indicator of rate of deposition, since the dates for layers 2 and 5 are only some 500 years apart, whereas those for layer 9 are at least 2 000 years older than that for layer 5.

As independent assessment of the date for layer 9 was sought as, although the first series of dates for the site showed reasonable consistency, the date for layer 9 was thought to be too young. This layer appeared to mark the beginning of the 'Wilton' at the site, but dates for other sites such as Wilton (J. Deacon 1972: 36) and Melkhoutboom (H. J. Deacon 1976, table 2) indicated that, in the eastern Cape at least, this occurred at a time closer to 8 000 B.P. In the event, the University of Washington date confirmed the accuracy of the

C.S.I.R. (Pta-) date. Subsequently published dates for sites in the southern Cape such as Nelson Bay Cave (J. Deacon 1978: 101; fig. 2) and Boomplaas (H. J. Deacon *et al.* 1978, fig. 2) indicate that in this area the introduction of the 'Wilton' occurred at about the same time as at BNK 1.

The closeness of the two dates for layer 9 does not indicate a hiatus between the deposition of the two sub-units. The relatively high frequencies of roof spalls and microfauna in the upper sub-unit may, however, indicate a hiatus in the human occupation of the site between the lower part of layer 9 and layer 8. A limited analysis of scraper morphology (cf. Fig. 17) suggests that layer 9 might have been intermediate between the industries of the underlying and overlying layers, but in almost every other respect this layer has more in common with the overlying layers than with those below it.

The date for layer 10 is consistent with the dates for layer 9 and, in terms of depth of deposit, layer 12, but the difference of some 2 000 years between the dates for layers 12 and 14 suggests either a period of reduced deposition or an occupation hiatus. Analyses of the artefacts and, to a lesser extent, the fauna indicate that this was a period of change in the ecology of the human occupants of the site, but D. M. Avery's analysis of the microfauna suggests an environmental change at about the time layer 10 was deposited (D. M. Avery 1979: cf. Table 22 of the present report).

The approximately 3 000 years taken for the deposition of layers 19–15 indicate yet another period of low rate of deposition. This is to some extent confirmed by the average density of stone artefacts in layers 17–13, which is the lowest in the layers below layer 4 (Table 2), although the faunal samples indicate a qualitative rather than a quantitative change where mammals are concerned (Table 15).

Although the series of dates obtained for BNK 1 is adequate for establishing the period of occupation of the site and indicates the chronology of the major events, the uncertainties regarding the undated layers highlight the need for greater numbers of radiocarbon dates. Some of the chronostratigraphic problems are possibly related to the combining of individual stratigraphic units into larger layer units, but present circumstances preclude the obtaining of large numbers of dates from test excavations that would indicate the strategy to be employed in excavation and subsequent analysis of the excavated material.

The possibility of breaks in the human occupation of the site cannot be ruled out, but these are not clearly indicated by the sequence of dates, nor by the artefactual and faunal components. With the possible exception of the upper sub-unit of layer 9, or a part of it, there are no archaeologically sterile deposits and this suggests that the cave was in more or less constant use from about 12 500 years ago. Comparison of the depth of deposit in the various layers, which is in part relative to the amount of debris left in the cave by its human occupants, suggests that during the period 6 000–4 000 B.P. the cave was relatively more intensely occupied than during the preceding or succeeding periods. This observation is to a large extent supported by the artefact fre-

quencies, although layers 11 and 12 have the highest average density of stone artefacts of all the layers (Table 2).

METHODS OF ANALYSIS

All the material recovered from the excavations was washed in the laboratory before further analysis was undertaken. Material from the 1974 excavation was accessioned under the reference AA8727 and that from the 1976 excavation under AA8743. The artefactual material was sorted into three main categories, stone, bone, and shell, and two minor ones, pottery and metal. The non-artefactual material was sorted into mammals, shell-fish, fish, micromammals, reptiles, birds, and plant remains.

The differences in the excavated volumes of the layers give rise to problems in the comparison of the frequencies of the material from the layers. Layer 1, for example, has almost ten times the excavated volume of layer 3 and twice that of layer 5; and layers 14–19 were not excavated in square P 30.

In an attempt to remedy the distortion of data resulting from these unequal volumes, an innovation in this report is the use, where appropriate, of what has been termed the 'average density', abbreviated in the text to AD. This was obtained by dividing the number of components of the various categories in each layer by the amount of the excavated volume of that layer. This gives the average density of components per cubic metre. Since only layers 1, 5, and 9 have an excavated volume in excess of a cubic metre, the calculated average density is greater than the actual frequency in all but these three layers.

It is appreciated that ADs are not the ultimate solution to the problem of comparing quantities of material from deposits of unequal volume, particularly as in most cases they yield inflated frequencies and they do not take into account compression of lower deposits; but it is none the less considered that they provide a more equitable basis for comparison than one that ignores the fact of unequal volume.

SUMMARY

The excavations, carried out in 1973–6, covered an area of 11,5 m², of which 4 m² were excavated to a depth of about 50 cm and another square metre taken down to about 90 cm short of bedrock, the remaining 6,5 m² being excavated to bedrock which was reached at a depth of approximately 3 m from the surface.

The deposit, of which the stratigraphy was seldom well defined, was divided into twenty major stratigraphic units or layers. The uppermost layer, layer +, was considered to have been disturbed and the material recovered was not included in the analyses, nor was that from the test pit, grid squares P–Q 26.

A series of twelve radiocarbon dates shows the site to have been occupied from about 12 700 to 255 B.P. There are certain anomalies, particularly with regard to layer 1, the sub-units of which span close on 3 000 years. The

possibility cannot be excluded that there were breaks in the occupation of the cave, between layers 14 and 12, 9 and 8, and in layer 1. However, on the evidence of the low artefactual content of layers 17–13, the apparently anomalous groups of dates may indicate periods when the cave was only sporadically occupied, and others when it was more intensively used, particularly during the deposition of layers 9–5.

In an attempt to overcome the problems caused by the layers having different excavated volumes, a system, ADs, has been introduced in which the frequency of artefacts or faunal remains is given as a ratio of the excavated volume of the layer.

THE ARTEFACT ASSEMBLAGE

STONE ARTEFACTS

Over 160 000 pieces of artefactual stone were recovered from the deposits. Although frequencies of what may be termed diagnostic artefacts are low, as is usual, sample sizes for individual layers in the various artefact classes are generally adequate for meaningful analysis.

RAW MATERIALS

Figure 7 indicates the percentage frequencies of the major raw materials in each layer. Chalcedony (0,2% of the site total) and shale (0,01%) are not included because of their negligible frequencies.

Quartz

This accounts for 46,2 per cent of the site total and falls below 40 per cent of the total of all raw materials in any layer only in layers 16 and 9–5. Frequencies decline in layers 19–16, increase in layers 15–11, decline in layers 10–6 and increase again to layer 1, which has the highest frequency of quartz (65,3% of the layer total of all raw materials) after layer 19 (66,3%).

Silcrete

This accounts for 22,0 per cent of the site total and shows a marked secular trend. Frequencies are low below layer 12 but increase to a maximum occurrence in layers 9–5, ranging from 28,7 per cent of the layer total in layer 7 to 41,9 per cent in layer 5. From layer 4 up, frequencies decline again in favour of quartz and quartzite.

Quartzite

This accounts for 26,5 per cent of the site total and shows a clear secular trend in the lower layers, increasing from layer 19 to a peak (67,7% of the layer total) in layer 16. Thereafter frequencies decline, reaching a low (18,6%) in layer 11 after which they are generally stable at around 25 per cent of layer totals except in layer 6 (34,0%), layer 5 (19,9%), and layer 1 (18,3%).

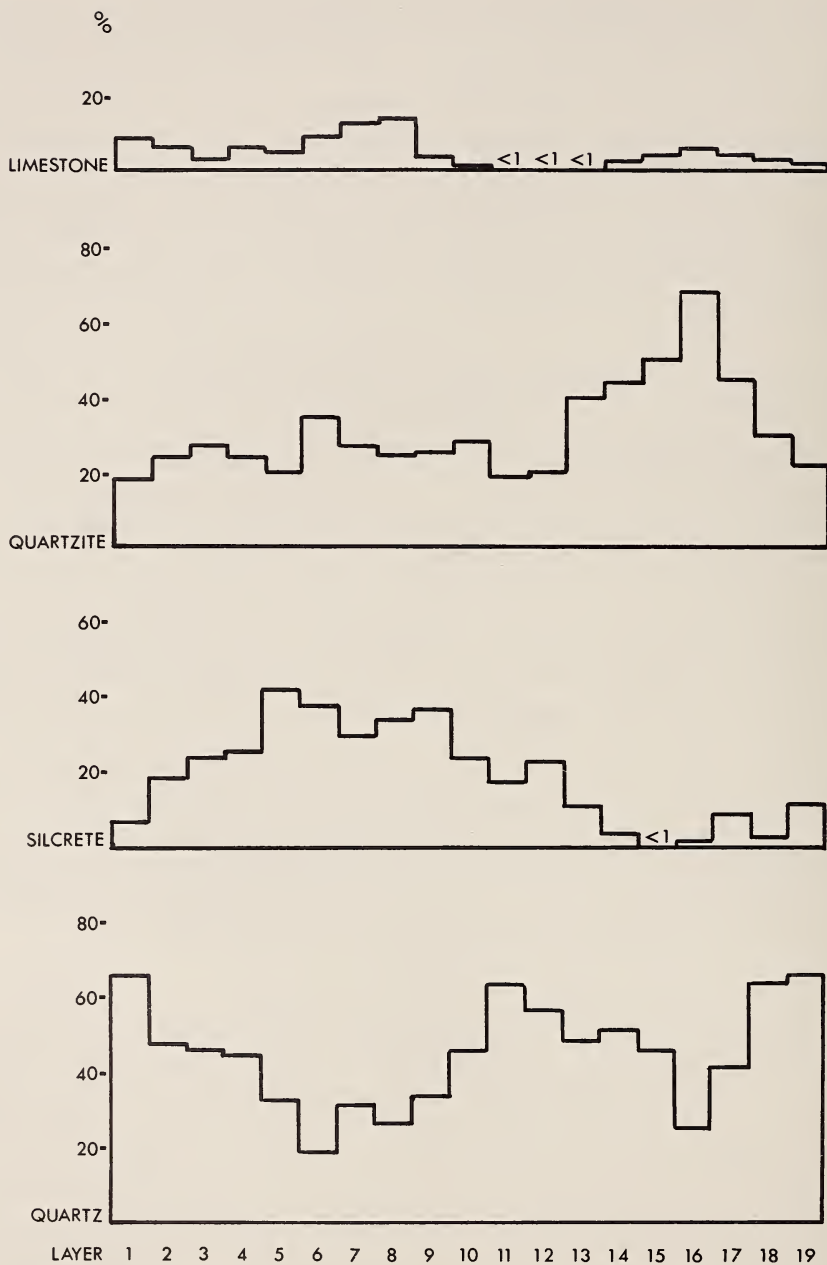


Fig. 7. Histograms of percentage frequencies, by layer, of stone artefact raw materials. <1 = less than 1 per cent of the layer total. Frequencies of chalcedony and shale, each less than 1 per cent of the site total, are not included.

Limestone

This accounts for only 5,1 per cent of the site total and has low frequencies in most layers, exceeding 10 per cent of the layer total only in layers 8 and 7. The weak secular trends, with peaks in layers 16 and 8, are not considered significant.

Other aspects of raw material use are discussed in the analyses that follow.

MAJOR ARTEFACT CATEGORIES

Following usual practice, the artefacts have been divided into three major categories, although with changes of name. The inventory of these categories is given in Table 2 and the individual categories are discussed below. Table 3 gives the frequencies of raw materials in the categories in each of the layers. Although raw material frequencies form part of the following discussions, it is worth noting from the outset that the secular variations in raw material frequencies shown in Figure 7 are reflected mainly in the unmodified artefact category only. Silcrete is the predominant raw material in both the utilized-modified and retouched artefact categories. The only exceptions are, in the utilized-modified artefact category, layer 15 in which the two artefacts are made

TABLE 2
Stone: inventory of major artefact categories.

Category:	unmodified		utilized-modified		retouched		layer total		AD/m ³
Layer	no.	%	no.	%	no.	%	no.	%	
1.....	16 477	97,9	80	0,5	276	1,6	16 833	10,3	6 474
2.....	2 032	93,9	24	1,1	108	5,0	2 164	1,3	3 796
3.....	1 902	93,9	23	1,1	100	4,9	2 025	1,2	8 100
4.....	6 373	94,0	97	1,4	310	4,6	6 780	4,1	7 450
5.....	14 015	94,0	146	1,0	740	5,0	14 901	9,1	12 017
6.....	9 840	94,5	126	1,2	448	4,3	10 414	6,4	12 398
7.....	10 262	95,9	92	0,9	351	3,3	10 705	6,5	13 216
8.....	10 203	96,0	138	1,3	291	2,7	10 632	6,5	18 331
9.....	15 686	96,8	125	0,8	385	2,4	16 196	9,9	15 878
10.....	7 143	97,7	68	0,9	103	1,4	7 314	4,5	13 061
11.....	7 364	99,0	23	0,3	54	0,7	7 441	4,5	26 575
12.....	13 310	98,1	103	0,8	150	1,1	13 563	8,3	24 220
13.....	3 979	98,8	20	0,5	29	0,7	4 028	2,5	8 951
14.....	4 447	99,5	16	0,4	8	0,2	4 471	2,7	5 806
15.....	2 034	99,7	2	0,1	3	0,1	2 039	1,2	3 398
16.....	3 292	99,6	8	0,2	5	0,1	3 305	2,0	5 330
17.....	4 064	99,6	8	0,2	7	0,2	4 079	2,5	7 156
18.....	9 831	99,2	56	0,6	18	0,2	9 905	6,0	15 238
19.....	16 742	99,5	66	0,4	18	0,1	16 826	10,3	17 169
Site total.....	158 996	97,2	1 221	0,7	3 404	2,1	163 621		

Note. Percentages in the first three columns are of the layer total; those in the last column are of the site total.

AD/m³ = average density per cubic metre (see p. 24).

TABLE 3

Stone: frequencies, by layer, of raw materials in the artefact categories.

Category:	unmodified					utilized-modified					retouched				
Raw material: Layer	Q	S	Qt	L	O	Q	S	Qt	L	O	Q	S	Qt	L	O
1.....	66,1	6,1	18,5	9,1	0,1	(21)	(39)	(19)	—	(1)	30,8	65,9	2,2	0,4	0,7
2.....	50,8	15,3	25,5	7,9	0,4	(11)	(12)	(1)	—	—	13,9	84,2	—	1,8	—
3.....	47,2	20,6	28,4	3,6	0,2	(9)	(14)	—	—	—	19,0	77,0	3,0	—	1,0
4.....	46,8	21,3	25,4	6,2	0,4	(23)	(70)	(2)	(1)	(1)	20,3	78,1	1,3	0,3	—
5.....	34,8	39,0	21,1	5,0	0,2	13,0	77,4	8,2	—	1,4	9,0	89,5	0,7	0,4	0,4
6.....	19,5	34,4	35,9	9,8	0,4	15,1	79,4	2,4	1,6	1,6	4,9	92,4	0,7	1,1	0,9
7.....	32,3	26,3	27,7	13,3	0,4	(9)	(74)	(7)	(1)	(1)	9,4	86,9	2,0	0,6	1,1
8.....	27,4	32,1	26,3	13,9	0,3	13,0	85,5	0,7	—	0,7	9,8	85,9	1,3	0,3	0,7
9.....	35,3	35,2	25,8	3,4	0,2	16,8	80,0	2,4	—	0,8	4,4	93,3	1,5	0,5	0,3
10.....	46,9	23,0	28,8	1,2	0,06	(11)	(56)	—	—	(1)	8,7	87,4	3,9	—	—
11.....	64,0	16,8	18,7	0,3	0,05	(4)	(15)	(2)	—	(2)	(5)	(44)	(4)	—	(1)
12.....	57,2	21,6	20,9	0,2	0,01	41,7	58,2	—	—	—	18,7	80,0	1,3	—	—
13.....	49,1	10,6	40,1	0,2	—	(6)	(12)	(2)	—	—	(4)	(24)	(1)	—	—
14.....	50,7	3,6	43,8	1,8	0,02	(4)	(9)	(3)	—	—	(3)	(5)	—	—	—
15.....	46,6	0,6	50,0	2,7	—	(1)	—	(1)	—	—	—	(2)	(1)	—	—
16.....	24,6	1,5	67,9	5,9	0,03	—	(6)	(2)	—	—	(2)	(3)	—	—	—
17.....	41,1	9,1	44,8	4,9	0,05	(2)	(5)	(1)	—	—	(1)	(3)	(3)	—	—
18.....	63,9	2,7	30,4	2,8	0,2	(37)	(18)	(1)	—	—	(3)	(12)	(3)	—	—
19.....	66,5	10,3	21,6	1,5	0,05	(10)	(49)	(7)	—	—	—	(8)	(10)	—	—
Site total.....	47,2	20,2	27,2	5,2	0,2	22,0	71,3	5,5	0,3	0,9	11,9	85,2	1,9	0,5	0,5

Note. Raw materials: Q = quartz, S = silcrete, Qt = quartzite, L = limestone, O = other (chalcidony and shale).

Where category totals are 100 or more, percentage frequencies are given, but where totals are less than 100 the actual frequencies are given in parentheses.

of quartz and quartzite, and layer 18 in which quartz predominates. In the retouched artefact category, in layer 17 silcrete and quartzite have equal, if low, frequencies, and in layer 19 there are two more quartzite artefacts than there are silcrete.

UNMODIFIED ARTEFACTS

The name of this category has been changed from the more commonly used 'waste' in recognition of the possibility that many of the artefacts included in this category might have had a potential for use and because of the probability that artefacts, particularly those in quartz and quartzite, have been included that were, in fact, used but the evidence for which is not readily detectable.

Table 4 provides an inventory of the frequencies in the classes that make up this category, which are discussed below.

Chips

These are pieces of less than 10 mm maximum dimension, which comprise the major component (50,9%) of this category. This class includes small flakes, but blades are included in a separate class, irrespective of their length.

TABLE 4
Stone: inventory of classes of unmodified artefacts.

Class:	chips	chunks	flakes	blades	radial	cores blade	irreg.	total	layer total	AD/m ³
Layer										
1	9 212	3 611	3 574	23	29	3	25	57	16 477	6 337
2	616	687	702	15	8	—	4	12	2 032	3 565
3	846	478	558	4	8	3	5	16	1 902	7 608
4	2 364	1 895	2 061	17	20	6	10	36	6 373	7 003
5	5 384	3 179	5 250	146	24	5	27	56	14 015	11 302
6	3 957	2 412	3 340	76	21	1	33	55	9 840	11 714
7	4 417	1 652	4 053	69	43	6	22	71	10 262	12 669
8	4 253	3 123	2 690	88	16	4	29	49	10 203	17 591
9	7 114	3 195	5 165	144	18	11	39	68	15 686	15 378
10	3 395	1 549	2 119	53	10	8	9	27	7 143	12 755
11	4 746	1 250	1 328	25	5	1	9	15	7 364	26 300
12	8 955	2 416	1 863	42	14	2	18	34	13 310	23 768
13	2 081	662	1 198	13	12	2	11	25	3 979	8 842
14	2 234	1 256	948	2	3	2	2	7	4 447	5 762
15	811	658	550	1	6	2	6	14	2 034	3 390
16	1 604	1 081	590	5	2	3	7	12	3 292	5 310
17	2 109	1 096	825	24	2	4	4	10	4 064	7 130
18	6 987	2 214	592	22	2	10	4	16	9 831	15 125
19	9 815	3 917	2 729	168	30	40	43	113	16 742	17 084
Site total	80 900	36 331	40 135	937	273	113	307	693	158 996	

Note. AD/m³ = average density per cubic metre (see p. 24).

Quartz accounts for 63,1 per cent of the chips and is followed by quartzite (18,8%), silcrete (16,6%) and limestone (2,1%), with chalcedony and shale making up the remaining 0,2 per cent of the site total.

Chunks

These are defined as pieces of irregular shape not showing a recognizable platform or bulbar scar, and are considered to be pieces that have been broken rather than deliberately shaped. The class probably includes a number of cores, since these are apparently under-represented (see below) and might not have been recognized as such.

Chunks comprise 22,8 per cent of the category total and are predominantly quartzite (37,3% of the class total) and quartz (36,1%) with low frequencies of silcrete (19,4%) and limestone (7,0%).

Flakes

Flakes are artefacts with a discernible platform, bulbar scar and/or recognizable dorsal and ventral surfaces, and which are not blades (see below). They account for 25,9 per cent of the unmodified artefact category.

Quartzite is the most common raw material (37,4% of the class total), followed by silcrete (26,5%) and quartz (25,9%), while limestone accounts for only 10 per cent of the site total.

Although counts were not made, it was noted during sorting that an apparently high proportion of the quartzite flakes are split down their length, from their point of impact. This may in part account for their slightly higher frequency. Some indication of the frequency of broken flakes is given in Figure 8, where the number of unbroken quartzite flakes in each layer of the 1974 sample is given as a percentage of the total number of quartzite flakes in the layer. The frequency of unbroken flakes ranges from 27–72 per cent of individual layer totals, with a site mean of 54.4 per cent. This indicates that, although the frequency varies from layer to layer, the overall proportion of broken flakes is high.

The proportion of quartzite flakes to flakes of all other raw materials ranges from 34–76 per cent of the layer total in the layers below layer 12 and from 29–48 per cent in the layers from layer 12 up.

Hewitt (1931: 545) observed that in the layers underlying the 'Wilton' deposits at Melkhoutboom 'were many large flakes and cores from which they were made, all from boulders and pebbles of Witteberg sandstone'. Further in the same report, Hewitt (1931: 547) commented that 'this pebble industry seems undoubtedly related to the typical Wilton and occurs to some extent in nearly all levels: it may merely be a sandstone phase of the industry'.

Hewitt's reference to 'large flakes' suggested that there might be differences in the size of the quartzite flakes from the 'Wilton' deposits and those from the underlying deposits. It was therefore decided to measure a sample of those from BNK 1, especially in view of the predominance of quartzite in some of the lower layers. The length and width of a total of 4 490 unbroken flakes from the 1974 excavation were measured and the results are shown diagrammatically in Figure 8. Where length is concerned, the means for layers 19–9 vary erratically from layer to layer, while in layers 8–1 there is a trend of increasing length in successive layers. Although there are differences if pairs of layers are compared, the length of flakes in layers 19–9 is generally not significantly different from that of flakes in layers 8–1, as indicated by the $2 \times$ standard error bars in the diagrams. In width, there is no significant variation in layers 19–11, except in layer 17, while in layers 8–1 there is a generally increasing trend that matches the trend for length. The total range of variation of the means for all the layers is, however, only 10 mm in length and 7 mm in width, and it cannot be concluded that there is any real difference in the size of the quartzite flakes from the lower layers and those from the upper.

Blades

These are parallel-sided flakes with a length at least twice as great as the width. From discussions with J. Deacon and J. Parkington it would seem that in the analysis of the BNK 1 material this definition has perhaps been more rigidly adhered to than by other workers. In the classifying of the BNK 1 material the only exceptions that have been made to the criteria for blades are pieces with a length : width ratio of less than 2 : 1 that are clearly broken blades.

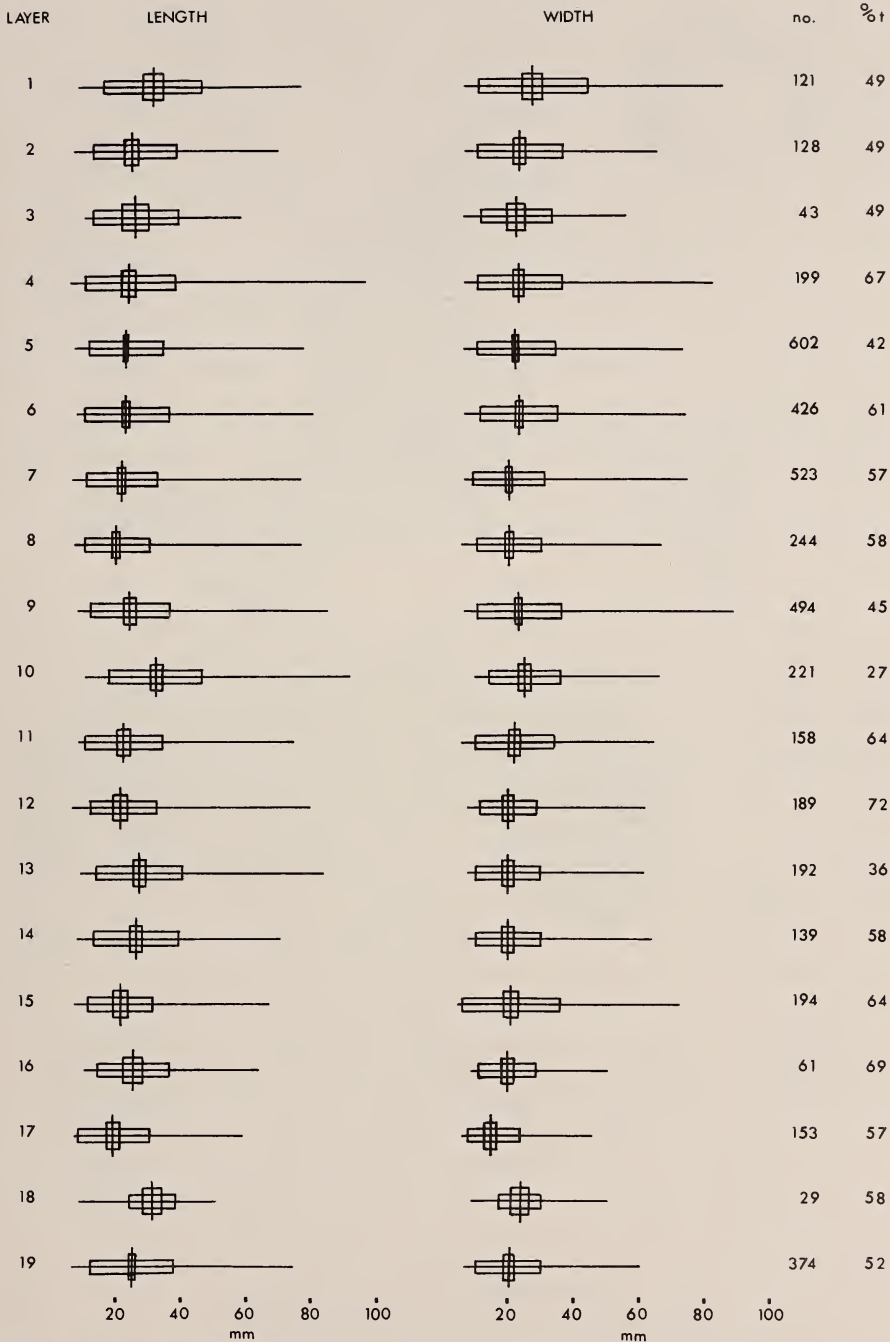


Fig. 8. Modified Dice-Leraas diagrams of dimensions of unbroken unmodified quartzite flakes from the 1974 sample. In each diagram the horizontal line indicates the absolute range, the vertical line the arithmetic mean, the longer bar one standard deviation on each side of the mean, the shorter bar two standard errors of the standard deviation (95% confidence limits) on each side of the mean. Frequencies in each layer sample are indicated on the right, together with the percentage frequency that this represents of the total number of flakes in the layer, the rest being broken.

The blades are predominantly silcrete (69% of the class total), with low frequencies of quartz (17,2%), quartzite (8,1%), limestone (5,5%), and chalcedony (0,1%). The only secular trend discernible in raw material usage is a decline from layer 9 to layer 6 in the frequency of quartz blades relative to quartzite and limestone, a trend that parallels the changes in overall raw material frequencies (Fig. 7). It is only in layer 1 that quartz replaces silcrete as the dominant raw material in this class, but since the difference is of only one blade (8:7) it cannot be considered significant.

The highest frequency of blades is in layer 19 (17,9% of the site total), while frequencies in layers 9–5 (7,4–15,6%) are consistently higher than in the remaining layers. The major difference between the blades from layer 19 and those from the overlying layers is that the majority of the blades from layer 19 are 'micro-blades' 15 mm or less in length. That very few of these 'micro-blades' were found with utilization or retouch suggests that if their production had been deliberate they were used in an unmodified form, and possibly away from the site more than at it. J. Deacon (1979 pers. comm.) has advised that similar small blades were found in discrete clusters or 'caches' at Boomplaas.

Cores

Cores are actually modified pieces but have been included in the unmodified category because their modification was incidental to the production of flakes or blades and the cores themselves represent discarded material. The analysis of the cores from BNK 1 follows J. Deacon (1978, table 1) in dividing them into three sub-classes, radial, blade and irregular. This classification was carried out for the BNK 1 cores without much confidence: there are cores that do not fit readily into the two more 'formal' sub-classes and yet are more than merely irregular; and it was, in general, easier to distinguish between blade cores and other cores than it was to decide whether a core was strictly radial or should be classed as irregular.

Radial cores are those from which flakes have been struck from the circumference of a discoidal core towards its centre (Fig. 9A–B, E). The frequency of these is generally relative to the overall frequency of stone artefacts in the layers (Tables 2, 4) and no secular trends were discernible.

Blade cores are those that show parallel-sided flake scars that are at least twice as long as they are wide. Cores with convergent-sided flake scars or scars with a length : width ratio of less than 2 : 1 have not been included, although a study of the blade cores from Nelson Bay Cave illustrated by J. Deacon (1978, fig. 9) suggests that many of the cores in the BNK 1 sample that were excluded from the blade core sub-class would have been included had they been found at Nelson Bay Cave.

Blade cores have been divided into three size classes:

1. blade: flake scars more than 25 mm long (Fig. 9D);
2. bladelet: flake scars 15–25 mm long (Fig. 9F);
3. micro-blade: flake scars less than 15 mm long (Fig. 9C, G–I).



Fig. 9. Cores. A-B, E. Radial. D. Blade. F. 'Bladelet'. C, G-I. 'Micro-blade'. A. Limestone, layer 1. B. Quartz, layer 1. C. Silcrete, layer 3. D. Silcrete, layer 9. E. Silcrete, layer 10. F. Silcrete, layer 5. G. Quartz, layer 18. H-I. Quartz, layer 19.

Frequencies in each size class are given in Table 5, which also includes raw material frequencies.

TABLE 5

Stone: blade cores; frequencies in size categories, in raw material classes, with core:blade ratios.

Flake scar length:	Blade > 25 mm			Bladelet 25–15 mm			Micro-blade < 15 mm			Layer total	Core:blade ratio
Raw material:	Q	S	Qt	Q	S	Qt	Q	S	Qt		
Layer											
1.....	—	—	—	—	1	—	2	—	—	3	1:8
2.....	—	—	—	—	—	—	—	—	—	—	0:15
3.....	—	—	—	—	1	—	1	1	—	3	1:1,3
4.....	—	—	—	—	—	—	3	3	—	6	1:4,2
5.....	—	1	—	—	2	—	1	1	—	5	1:31
6.....	—	—	—	1	—	—	—	—	—	1	1:80
7.....	—	—	—	—	3	—	—	3	—	6	1:11,8
8.....	—	—	—	—	3	—	—	1	—	4	1:25,2
9.....	—	1	—	—	3	—	6	1	—	11	1:14,4
10.....	1	—	—	1	3	—	2	1	—	8	1:7,5
11.....	—	—	—	—	—	—	—	1	—	1	1:25
12.....	—	—	—	—	—	—	1	1	—	2	1:22,5
13.....	1	—	—	1	—	—	—	—	—	2	1:6,5
14.....	—	—	—	—	—	—	1	1	—	2	1:1
15.....	—	—	—	—	—	—	2	—	—	2	1:0,5
16.....	—	—	—	—	—	—	3	—	—	3	1:1,7
17.....	—	—	—	—	—	—	4	—	—	4	1:6
18.....	—	—	—	1	—	—	9	—	—	10	1:3,2
19.....	—	—	1	1	1	—	34	3	—	40	1:4,8
Site total.....	2	2	1	5	17	—	69	17	—	113	1:9,1

Note. Raw materials: Q = quartz, S = silcrete, Qt = quartzite.

The core:blade ratios are based on the total of all unbroken blades, unmodified, utilized, and retouched.

Blade cores are too few to warrant comment beyond pointing out that they occur sporadically throughout the deposit. Most of the bladelet cores are from layer 10 and above, with almost three-quarters of the site total in layers 10–5. Micro-blade cores have the highest frequency of the three size classes (76,1 % of the site total) and, although they were found in all but three of the layers, almost half the total came from layer 19 alone. This layer also has the highest frequency of unmodified blades, AD as well as actual (Table 4).

As will be seen from Table 5, almost all the micro-blade cores from layers 19 and 18 are quartz, and are of the type illustrated in Figure 9G–I. Initially these were not considered to be cores, but the identification of similar quartz artefacts from Nelson Bay Cave as cores (J. Deacon 1978, fig. 9: 16–18) has resulted in those from BNK 1 being accepted as such. There appears to be some similarity between these cores and the smaller scaled pieces (see below), and it seems open to question as to whether some of the artefacts from BNK 1

classed as micro-blade cores are not in fact broken scaled pieces, or whether some of those classed as scaled pieces are not actually cores.

Irregular cores are those that cannot be included in either of the preceding sub-classes. As might be expected, they are the most common type of core (44,3% of the class total), although they are not much more common than radial cores (Table 4).

Silcrete is the most common raw material for cores (53,2% of the class total) and is the most common raw material for both radial (58,2% of the sub-class total) and irregular cores (56,7%). Quartz, however, is the most common raw material for the sub-class of blade cores (67,2%), although in the size classes there are more silcrete bladelet cores than quartz (Table 5).

No secular trends are discernible in the distribution of the three core types through the layers. Excluding layer 19, which has the highest number of blade and irregular cores (radial cores are most common in layer 7), the lower frequency of cores in the lower layers is consistent with the generally lower frequency of all artefactual material in these layers.

The ratio of blade cores to blades (in all categories), also shown in Table 5, shows neither consistent patterning, nor any secular trends. The ratio is lowest in layers 5-12 although these layers yielded about a third (33,5%) of all the blade cores.

Quartzite pebbles

These are not artefacts in the strict sense and have therefore not been included in any of the inventories. They are, however, 'manuports' that are not a component of the limestone rock and must have been brought into the cave. They are round to oval in shape and up to about 2 cm greatest diameter, and although they were not counted they occurred in sufficient frequency for their presence to warrant mention. These pebbles are too small to allow their being considered as potential cores and show no signs of having been used in any way. The reason for their presence in the deposits can thus only be speculated upon. Such speculations could include sling-shot or the equipment for a game.

Ochre

This was found throughout the deposit, in various colours ranging from yellow to dark brown. No attempt was made at quantification, but it was observed that some pieces showed wear consistent with their having been rubbed, while others had striations that suggested that they had been scraped. (See also *Combination hammerstones-grindstones, Marine shell ornaments, Pottery.*)

UTILIZED AND MODIFIED ARTEFACTS

Artefacts showing damage as a result of use or with modification of their shape by or for use (other than those classed as retouched pieces) account for 0,7 per cent of the site total of stone artefacts. They have been divided into eight classes and an inventory of these is given in Table 6.

TABLE 6
Stone: inventory of utilized-modified artefact category.

Class:	flakes	blades	scaled pieces	hammer-stones	combinations	ground/grooved	heavy edge-flaked	Layer total	AD/m ³
Layer									
1	27	—	37	12	1	—	3	80	31
2	8	—	15	1	—	—	—	24	42
3	9	—	14	—	—	—	—	23	92
4	43	5	48	1	—	—	—	97	107
5	74	4	61	4	—	2 ^a	1	146	118
6	62	3	56	1	—	2	2	126	150
7	38	2	51	1	—	—	—	92	114
8	84	13	41	—	—	—	—	138	238
9	71	9	45	—	—	—	—	125	122
10	42	7	19	—	—	—	—	68	121
11	13	—	8	—	1	1 ^b	—	23	82
12	52	3	48	—	—	—	—	103	184
13	15	—	5	—	—	—	—	20	44
14	10	—	5	—	—	—	1	16	21
15	—	—	1	1	—	—	—	2	3
16	2	—	4	—	1	—	1	8	13
17	4	2	2	—	—	—	—	8	14
18	7	10	39	—	—	—	—	56	86
19	31	22	16	3 ^c	—	—	—	72	67
Site total	592	80	515	24	3	5	8	1 227	

Note. a—1 bored stone fragment, 1 grooved stone; b—ground shale palette/pendant; c—includes 1 milled-edge pebble.

Silcrete is the dominant raw material (71,3% of the category total), followed by quartz (22,0%), quartzite (5,5%), shale (0,6%), limestone and chalcedony (0,3% each). Utilization is more easily observed on silcrete than on the other raw materials, and quartz and quartzite are probably under-represented in this category because of the difficulty in identifying utilization on these raw materials.

Utilized flakes

These account for 48,2 per cent of the category total. They are classified on the basis of relatively light chipping on the flake edge that is of sufficient extent to suggest that this resulted from deliberate human activity. The degree of edge damage, more often in the case of quartzite artefacts, caused problems in deciding whether an artefact should be classified as utilized or retouched, and it seems that there is no clear separation of these categories. Heavy utilization resulting in the removal of relatively large flakes from the edge can produce a form of modification of the flake that is similar to the deliberate, functional modification termed retouch.

The utilized flakes are almost all silcrete (90,5 % of the class total), so that frequencies of quartzite (5,2 %) and quartz (3,2 %) are low and those of limestone (0,7 %) and chalcedony (0,3 %) minimal. Frequencies are low in layers 18–13, 3 and 2 but there are otherwise no observable trends in the distribution through the layers.

Utilized blades

These account for 6,5 per cent of the category total. Their distribution in the layers follows that of utilized flakes more closely than it does those of unmodified blades or blade cores (Table 4) although they are absent from eight of the layers. Although layer 19 has a higher actual frequency than layer 8 the AD for both layers is the same.

Forty-nine of the blades are broken. Of the remainder, using the size classes defined for blade cores, 11 are blades, 9 bladelets, and 11 micro-blades. There is no discernible patterning in the distribution of the size classes in the layers.

Silcrete is the dominant raw material (97,5 % of the class total), with one blade each of quartzite and chalcedony making up the total. It is of some interest that, although quartz accounts for 67,2 per cent of the total of blade cores and 87,5 per cent of those in layer 19 alone, not one utilized quartz blade was found.

Scaled pieces

More commonly known as *pièces esquillées*, these are artefacts with chipping or crushing of one or more edges, usually but not necessarily the shorter edges of roughly rectangular pieces. As mentioned in the discussion of cores, some doubt exists as to whether some of the artefacts in the BNK 1 stone assemblage that have been classified as quartz micro-blade cores are not, in fact, broken scaled pieces, or whether some of those classed as scaled pieces are not actually cores. Some support for this observation is provided by the comment by J. Deacon (1972: 14) on the crushed edges of the *pièces esquillées* from Wilton: 'This sort of modification has often been found on worked-out bladelet cores and may possibly be due to attempts at removing further bladelets.'

As will be seen from Table 6, scaled pieces were found throughout the deposit, but with higher actual frequencies in layers 18, 12, 9–4, and 1. Although layer 5 has the highest actual frequency, it is layer 12 that has the highest AD, and the AD for layer 5 is, in fact, lower than those for layers 18, 12, 8–6 and 3. This provides a good example of the problems inherent in comparing the actual frequencies of material from deposits of unequal volume.

Although about 80 per cent of the micro-blade cores are quartz, the scaled pieces are more or less evenly divided between silcrete (50,3 % of the class total) and quartz (48,9 %), with four of chalcedony completing the total.

Hammerstones

In the BNK 1 sample, these are quartzite pebbles or cobbles with bruising and pitting on their ends and/or sides. As indicated in the notes on Table 6, the total for layer 19 includes a milled-edge pebble: a flat, circular pebble with bruising round its circumference (Fig. 10C).

Hammerstones account for only 2 per cent of the category total. Because they are distributed sporadically throughout the deposit, in only eight of the layers, lower as well as upper, no significance can be attached to their absence from any of the layers. That there are more in the upper layers than in the lower is consistent with the distribution of most of the artefact classes, but the fact that half the site total came from layer 1 is not entirely attributable to the fact that this layer has the largest excavated volume.

Combination hammerstones–grindstones

These are quartzite cobbles that have the characteristics of both hammerstones and upper grindstones: bruising and pitting from hammering and the flattening of end or side through grinding.

Only three of these artefacts were recovered, from layers 1, 11, and 16. That from layer 1 has its grinding-surface heavily stained with brownish ochre. That from layer 11 (Fig. 10A) is conventional in that it is an elongated cobble with grinding-wear at one end and pitting from hammering at the other. There is also a small amount of pitting on the ground surface. The third, from layer 16 (Fig. 10B), has grinding-wear on at least three of its six faces and pitting on its ends, one of which is also one of the ground surfaces. As indicated in the illustration, flakes have been struck from this piece so that it is technically also a core, but it has not been included in the counts for that class.

Ground stone artefacts

These shale pieces consist of bored stone fragments, a grooved stone and a broken palette or pendant. The bored stone fragments are from layers 5 and 6, and the fragments from layer 6 are clearly pieces of two different artefacts. The grooved stone, also from layer 5 (Fig. 11B) is somewhat unusual in being a worn pebble with the groove on the edge instead of across one of the flat surfaces.

The broken palette or pendant, from layer 11 (Fig. 11A), is a finely ground piece of shale whose surfaces have a metallic, pewter-like sheen. The perforation near the edge has been bored obliquely (i.e. grooved) from both sides.

Heavy edge-flaked pieces

These are split quartzite cobbles with evidence of large flakes having been struck from the cortical surface of the split edge (Fig. 12). Artefacts of this type were first described from Nelson Bay Cave (J. Deacon 1978: 91–92) and are also included in the stone artefacts from Die Kelders (Schweitzer 1979: 177–178). As indicated in Table 6, their distribution in the BNK 1 assemblage is sporadic and with low frequencies.

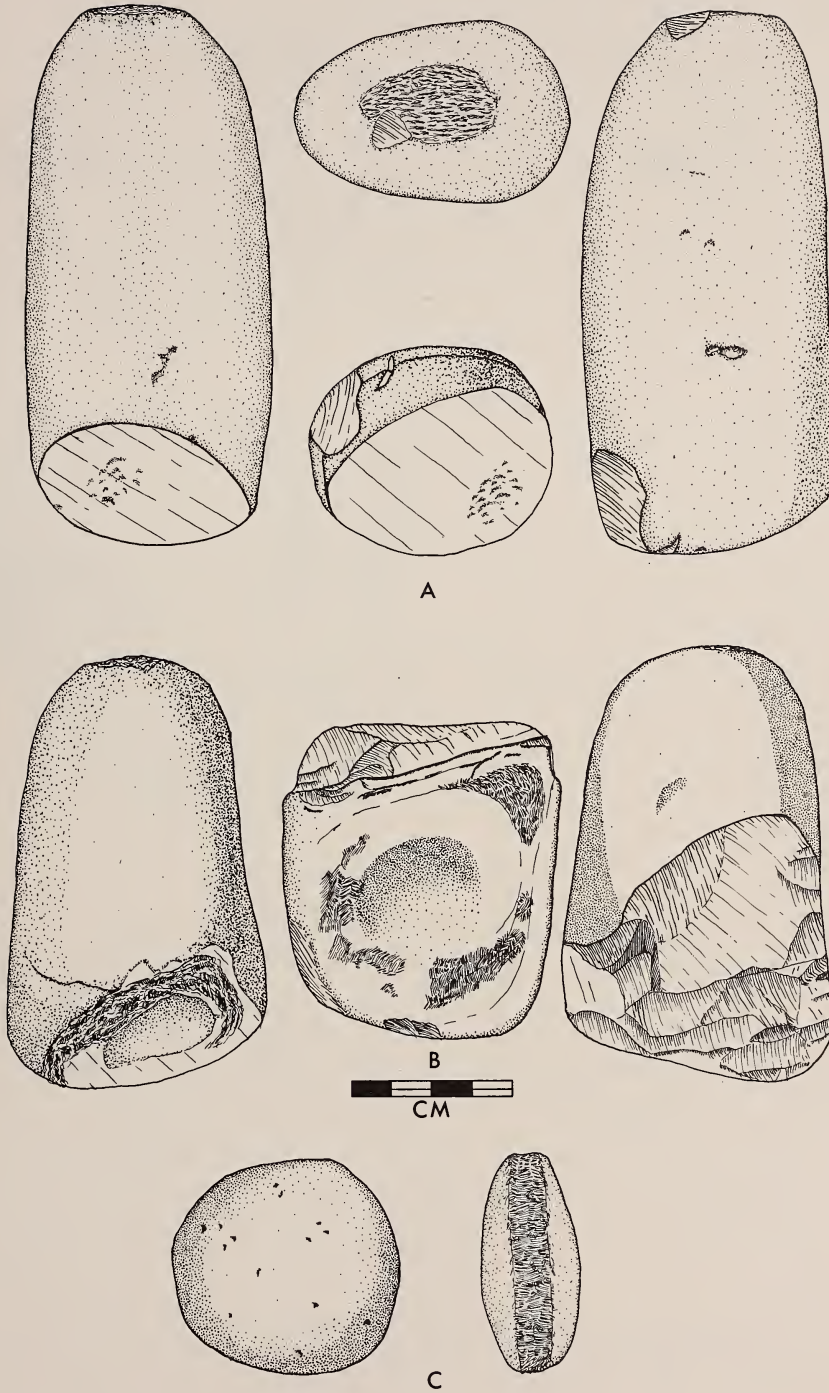


Fig. 10. A-B. Combination hammerstones-upper grindstones, quartzite, layers 11 and 16.
C. Milled-edge pebble, quartzite, layer 9.

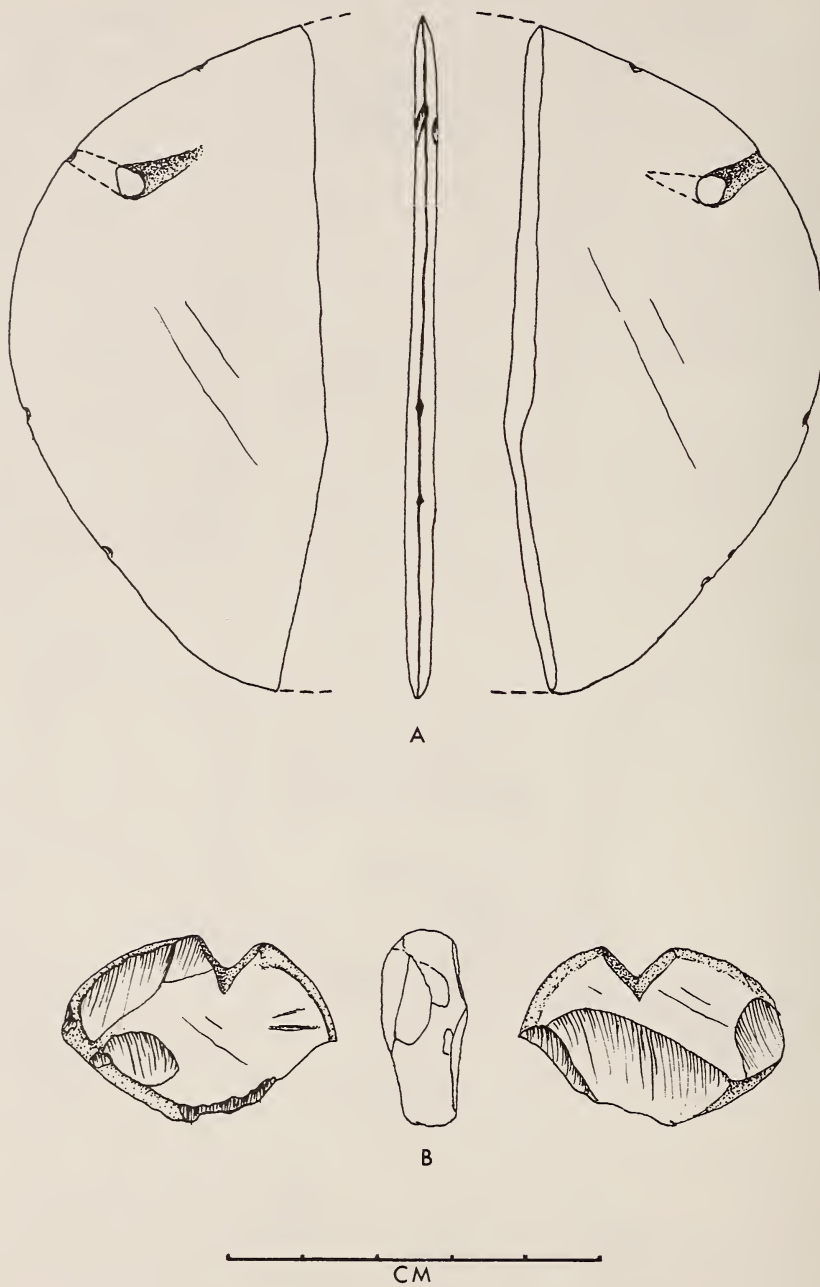


Fig. 11. A. Ground shale palette/pendant (broken), layer 11.
B. Grooved shale pebble, layer 5.

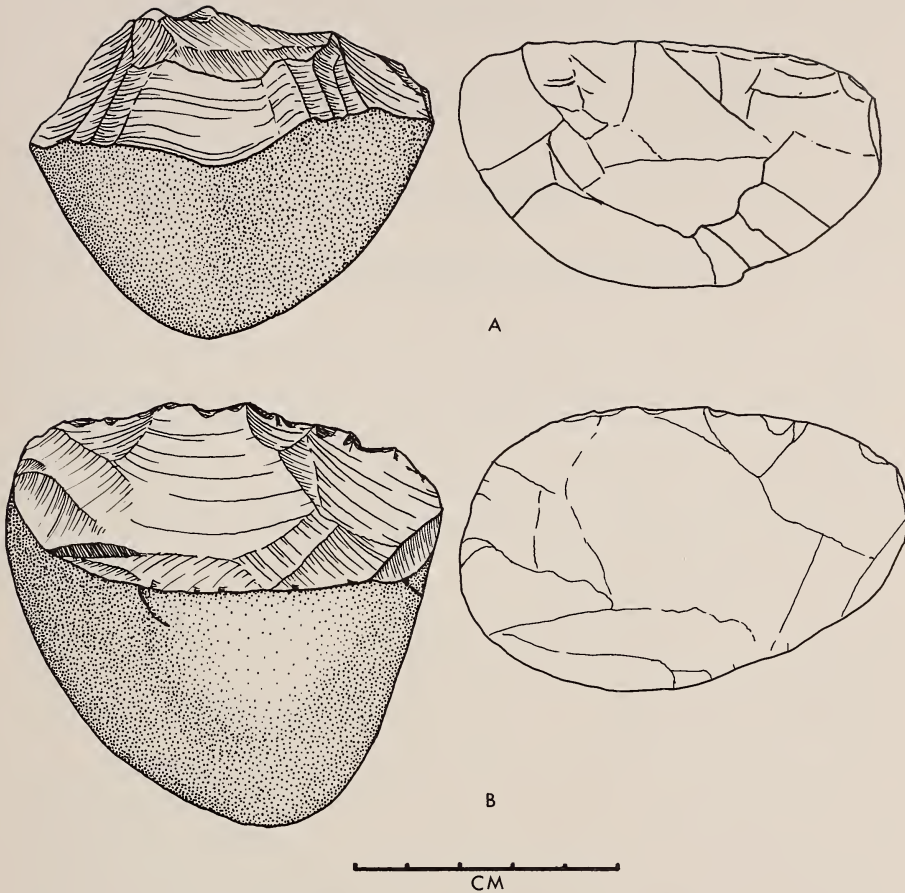


Fig. 12. Heavy edge-flaked pieces, quartzite. A. Layer 6. B. Layer 5.

RETOUCHED ARTEFACTS

The artefacts in this category are those that show deliberate modification of the 'blank' (flake, blade, etc.) for the purpose of creating either a specific shape, e.g. segments, or a particular type of working edge, e.g. scrapers. It also includes a number of pieces that resist formal classification and are therefore termed 'miscellaneous retouch'. The modification of these artefacts appears to have been deliberate and is generally distinct from the modification resulting from casual utilization. Some sub-classes can be recognized within the class of miscellaneous retouched artefacts, but the number of pieces is too low to warrant their being placed in a separate class.

Classification of the retouched artefacts follows the conventional typology, but there are problems that result from the degree to which the artefacts vary in their attributes. In very few instances is it possible to draw an absolutely

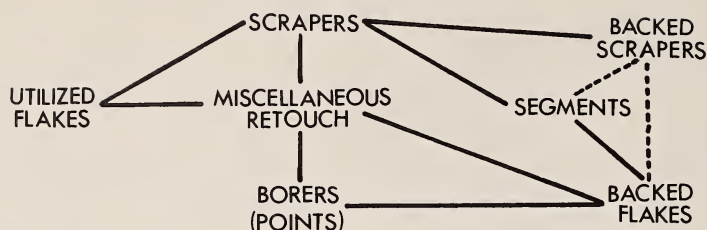


Fig. 13. Diagram indicating the intergrading of stone artefact types.
Broken lines indicate less common areas of intergrading.

clear-cut division between the classes or, as previously mentioned, between artefacts classified as utilized-modified and those classed as retouched. Figure 13 gives some indication of the directions of intergrading but it would require a multivariate attribute analysis to quantify the degree of intergrading in a meaningful manner. It is for this reason that the more usual term 'formal tools' is not used in this report, and aspects of the problem are touched on in the discussions of the various classes.

The inventory of the classes in the retouched artefact category is given in Table 7 and the layer frequencies in Figure 14, in histogram form. In general, the frequencies for the layers below layer 12 are too low to be amenable to meaningful statistical analysis or even conversion to percentage frequencies. Although this fact is clearly not without archaeological significance, it tends to create a bias in any discussion in favour of the upper layers.

As is the case with the utilized and modified artefacts, the dominant raw material for retouched artefacts is silcrete (85,2% of the category total), followed by quartz (11,9%), quartzite (1,9%), and negligible frequencies of limestone and chalcedony (0,5 % each). Quartz is not considered to be under-represented in this category through lack of recognition of retouch since modification of the shape makes recognition easier. There are secular trends in the frequencies of raw materials in certain classes, and these are discussed under the relevant heading.

Scrapers

These account for 52,1 per cent of the category total and, as indicated in Figure 14, are the dominant retouched artefact in every layer below layer 3. Examples of the more common types of scraper are illustrated in Figure 15, and of the 'extra large' types in Figure 16.

The ADs for scrapers are less than 10 in layers 14–17 and 19, less than 100 in layers 1–2, 13 and 18, less than 200 in layers 3–4, and 10–11, and less than 300 in layers 5, 7, 9 and 12, while layers 6 and 8 have ADs in excess of 300. There is thus no clear pattern of increase or decrease in the frequency of scrapers beyond the fact that layers 19–14 have the lowest ADs and layers 12 and 9–5 the highest. When scrapers are compared with other artefacts in the

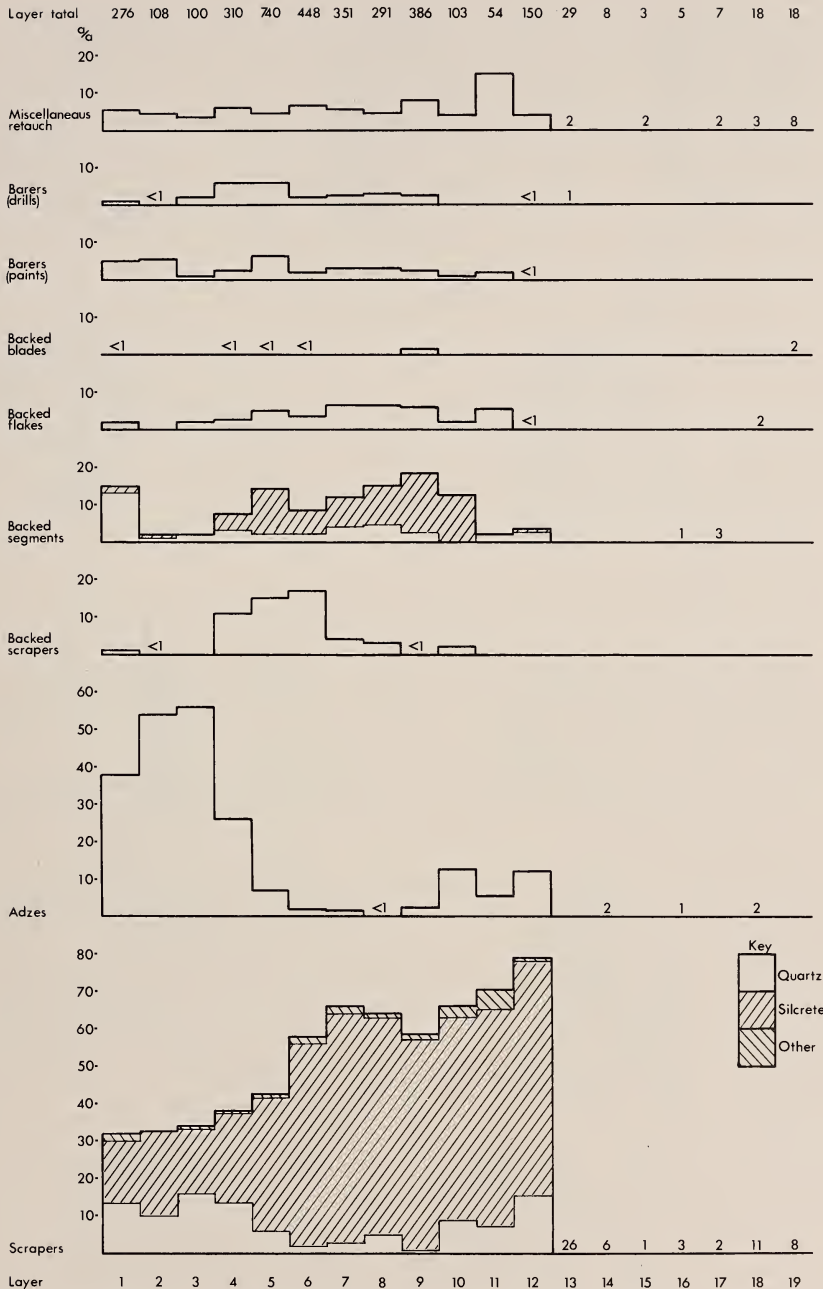


Fig. 14. Histograms of percentage frequencies, by layer, of retouched stone artefact classes. <1 = less than 1 per cent of the layer total given at the top of the figure. Frequencies in layers 13-19 are too low for conversion to percentages and the actual frequencies are given instead. Raw material frequencies are indicated for scrapers and segments only.

TABLE 7

Stone: inventory of retouched artefact category.

Class:	scrapers	adzes	scrapers	segments	trapezoids	backed pieces		flakes	blades	points (borers)	borers (drills)	notched flakes	misc.	Layer total	AD/m ³
						obliques									
Layer															
1	89	104	3	41	—	2	6	1	14	3	8	5	276	106	
2	35	58	1	2	—	—	—	—	6	1	2	3	108	189	
3	34	56	—	2	—	—	2	—	1	2	1	2	100	400	
4	118	80	34	23	—	5	7	3	8	18	7	7	310	340	
5	313	51	110	108	3	6	37	5	46	42	11	8	740	598	
6	260	9	75	37	1	9	19	1	10	9	7	11	448	533	
7	231	5	15	41	3	—	22	—	10	8	5	11	351	433	
8	186	2	9	44	1	2	19	—	8	9	2	9	291	502	
9	226	10	3	72	6	1	23	5	8	9	12	10	385	377	
10	68	13	2	13	—	—	2	—	1	—	1	3	103	184	
11	38	3	—	1	—	1	3	—	1	—	1	6	54	193	
12	118	18	—	5	—	—	1	—	1	1	1	5	150	268	
13	26	—	—	—	—	—	—	—	—	1	1	1	29	64	
14	6	2	—	—	—	—	—	—	—	—	—	—	8	10	
15	1	—	—	—	—	—	—	—	—	—	1	1	3	5	
16	3	1	—	1	—	—	—	—	—	—	—	—	5	8	
17	2	—	—	3	—	—	—	—	—	—	1	1	7	12	
18	11	2	—	—	—	—	2	—	—	—	1	2	18	28	
19	8	—	—	—	—	1	—	2	—	—	3	4	18	18	
Site total	1 773	414	252	393	14	27	143	17	114	103	65	89	3 404		



Fig. 15. Scrapers, general range. A. Silcrete, layer 10. B-C. Silcrete, layer 6. D, F. Silcrete, layer 4. E. Silcrete, layer 19. G-I. Silcrete, layer 1. J-K. Silcrete, layer 6.

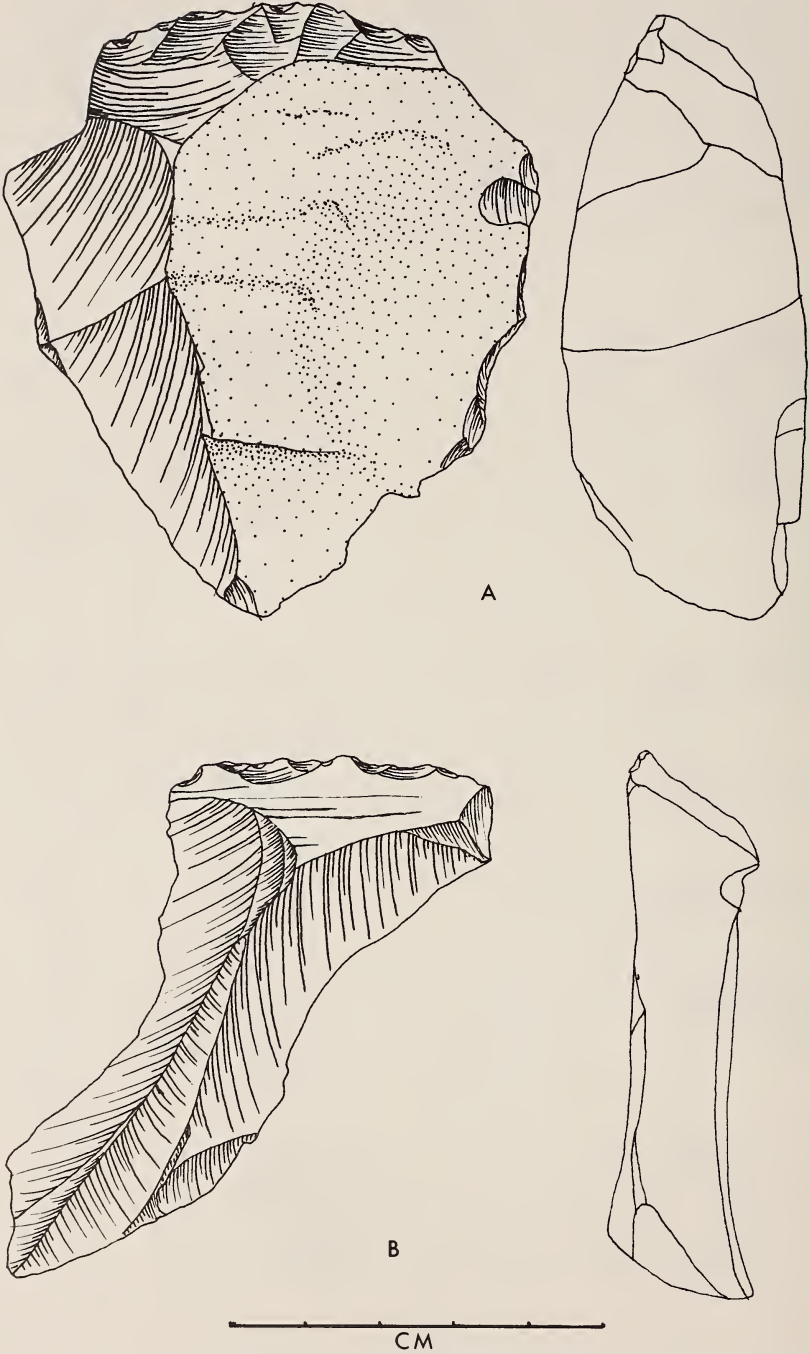


Fig. 16. 'Extra large' scrapers, both limestone. A. Layer 6. B. Layer 5.

category, however, there is a generally declining trend in the layer frequencies, as indicated in Figure 14.

Silcrete is the dominant raw material (83,8% of the class total), with only low frequencies of quartz (13,2%), quartzite (2,0%), limestone (0,7%) and chalcedony (0,3%). There are, however, discernible secular trends in the frequencies of quartz scrapers (Fig. 14). These decline from layer 12 (19,5% of the layer total) to layer 6 (3,1%) then increase sharply from layer 5 (14,1%) to layer 3, in which the frequency (47,0%) is almost equal to that of silcrete (50,0%). Lower frequencies of quartz occur in layers 2 and 1 (31,4% and 41,6%), but the ratio of quartz to silcrete is higher in these layers than in layer 5 and below. The quartz : silcrete ratio declines from 1 : 4 in layer 12 to 1 : 30 in layer 6, layer 9 having an anomalous 1 : 54. In layer 5 the ratio is 1 : 6; in layers 4-2, between 1 : 1 and 1 : 2; and in layer 1, 1 : 6.

A limited morphological analysis of scrapers was undertaken, measurements being taken of the three plane dimensions of all unbroken pieces. The results of this analysis, together with the length:width ratio, are presented graphically in Figure 17. What is immediately apparent is that secular variation is virtually identical for all four attributes. Frequencies in the layers below layer 12 are low, and therefore statistically less reliable, and those in layers 15-19 are too low for any meaningful observation. However, the trends may be summarized as follows:

- in layers 14-11 size increases, shape changes from wide to long;
- in layers 10-6 size decreases, shape changes from long to wide;
- in layers 5-1 size increases, shape changes from wide to equilateral.

Layer 14 appears to mark the beginning of the trend that continues until layer 10, while layers 15 and 17 in most respects reverse the trends indicated by layers 19, 18 and 16. The changes in size and shape are most marked in layers 12-10, with layer 9 intermediate between this group and layers 8-1. It must be pointed out, however, that layer 11 has three 'extra large' scrapers, $47 \times 45 \times 13$ mm, $50 \times 55 \times 19$ mm, and $63 \times 77 \times 21$ mm, and although scrapers of similar dimensions are found in most other layers the presence of three in a sample as small as that of layer 11 ($n=38$) helps account for the marked shift in the means for all the attributes indicated in Figure 17. In layers with higher frequencies these 'extra large' scraper dimensions are offset by the greater numbers of scrapers with dimensions within the normal range. The overall variation from layer 8 up is not great and, as indicated in Figure 17 by the $2 \times$ standard error bars, generally not statistically significant, so that scrapers from these layers may be considered as morphologically homogeneous.

There are fifty-three scrapers in the BNK 1 sample that have, in addition to the normal scraper retouch, step-flaking on their laterals of a kind usually associated with adzes (see below). These were recovered from layers 14-1 except layers 7 and 2. Layer 12 has twenty-one of these artefacts and layer 9 has eleven, but in the other layers frequencies are low.

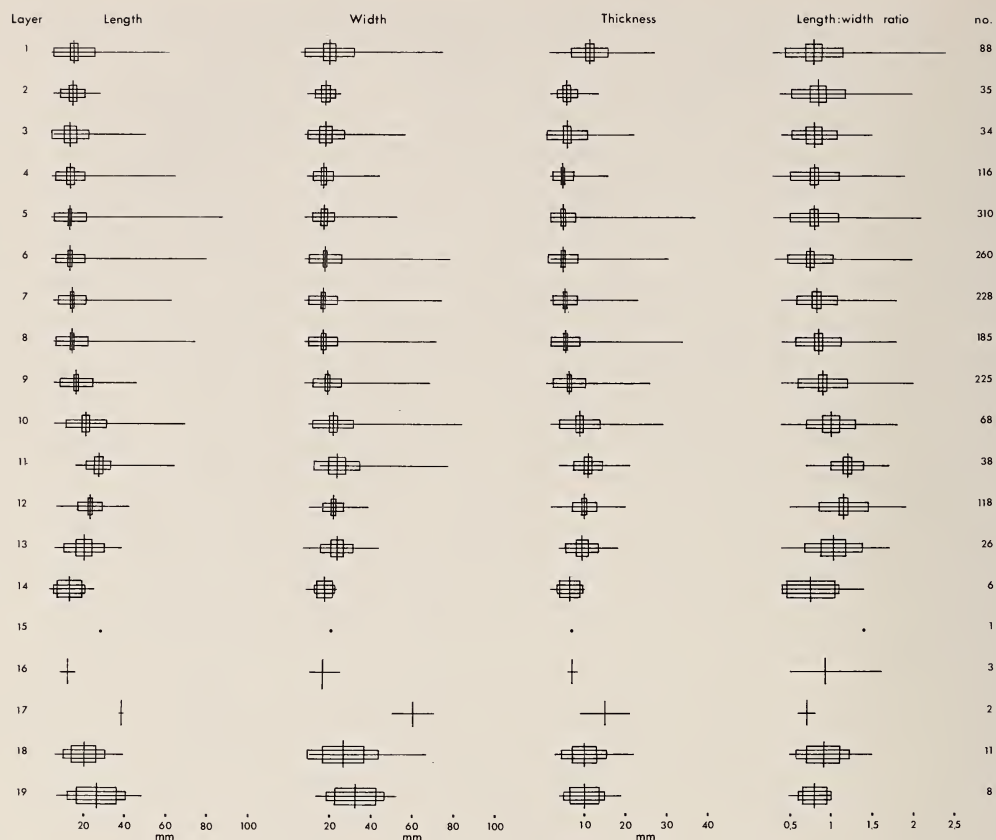


Fig. 17. Modified Dice-Leraas diagrams of scraper dimensions and length:width ratios. Layer sample frequencies are given on the right. For details of symbols, see Figure 8.

During the initial analyses it was considered that these artefacts represented a form transitional between the long, thick end-scrapers, which appeared more common in layers 13-10, and adzes proper, which become more common in the upper layers. In the preliminary report on BNK 1 (Schweitzer & Wilson 1978: 138) it was speculated that 'adzes and small scrapers may have taken over most of the functions previously fulfilled by medium and large scrapers'. However, these 'scraper-adzes' have their maximum frequency in layers 12 and 9, while adzes do not become common before layer 4, and the fact that this artefact type is found right up to layer 1 negates the possibility that it might represent a transitional stage between the industries of the lower layers and those of the upper. B. D. Malan has suggested (1980 pers. comm.) that these might merely be scrapers made on large flakes, of which the width was reduced in order to facilitate hafting.

A further sixty-one scrapers were found to show utilization of part of the unretouched edge. Apart from one in layer 19, these came from layer 12 and above but were not found in layers 11, 9 and 3, and the highest frequency (twenty-six) came from layer 5. These are another example of the intergrading of artefact types within and between categories and classes, and it is only the acutely-angled 'scraper' retouch that distinguishes these pieces from backed flakes (see below), many of which also show utilization of the unretouched edge. This utilization on the scrapers possibly represents casual use of an artefact primarily intended for another purpose. Although the number is few (3,4% of the scraper total), the evidence of utilization on these scrapers suggests that not all scrapers, or even all small scrapers, were mounted in mastic (cf. Deacon & Deacon 1980).

Scrapers with indisputable traces of mastic were not found in the BNK 1 sample, although there is one broken artefact included with the 'miscellaneous retouch' (see below and Fig. 24M) that is partly covered in mastic and may be a broken scraper.

Adzes

These are artefacts that have step-flaking on one or both of their laterals. They account for 12,2 per cent of the retouched artefact category but although they are present in fifteen of the layers, from layer 18 up, they only become a notable feature of the layer assemblages from layer 4 up. The ADs for these artefacts, as well as the percentage frequencies (Fig. 14), indicate that adzes are relatively most common in layer 3. They are almost all made of silcrete (98,5% of the class total), the remaining six being of quartz.

The adzes from BNK 1 are mostly oblong pieces made on thick flakes or chunks. Some are unilaterally retouched, others bilaterally, and some of the latter assume a convergent, more triangular shape. Attempts to classify adzes according to shape, size, or position of retouch were not satisfactory owing to the degree of variation within each layer sample. No typological or morphological trends could be discerned, and the examples illustrated in Figure 18 are representative of the site sample as a whole.

The dimensions of the adzes are generally consistent throughout the sequence. Length ranges from 11 to 47 mm with a mean of 26,2 mm, and width ranges from 6 to 37 mm with a mean of 17,3 mm. In all but three of the layer samples the length does not vary from the site mean by more than 1,5 mm. The exceptions are layers 7, 11 and 18 and the variation is 5,8–7,9 mm. The mean width of the layer samples shows more variation, with only eight of the samples varying from the site mean by 1,5 mm or less. In the other seven layers the mean varies from the site mean by 1,9–10,7 mm. However, despite the fact that the two adzes from layer 18 are larger than the rest (mean dimensions 32 × 28 mm) (Fig. 18G, K), no patterning is evident in the morphological variation.



Fig. 18. Adzes, all silcrete except C, which is crystal quartz. A, F, M. Layer 1. B-C, E, I. Layer 4. D, H, J, L. Layer 12. G, K. Layer 18. Stippled areas on A, C and F indicate cortex.

Although, as indicated in Table 7 and Figure 14, there are adzes in fifteen of the layers, below layer 12 there are only five (1,2% of the site total), in layers 14, 16 and 18. The distribution in layers 12–10, although irregular, is higher than in the layers immediately above or below; but, from a very low frequency in layer 8 ($n = 2$), there is a progressive increase in frequency in the overlying layers, which corresponds to a decline in scraper frequencies (Fig. 14). In layer 8 adzes account for only 0,7 per cent of the layer total of retouched artefacts and scrapers for 63,9 per cent, but by layer 3 adzes have increased to 56 per cent and scrapers have declined to 34 per cent. The decline in the frequency of adzes in the overlying layers, to 37,7 per cent in layer 1, is not matched by a corresponding increase in scraper frequencies, which reach only 32,2 per cent of the category total in that layer. The adze : scraper ratio in layer 1 is 1,2 : 1, as against 1,7 : 1 in layers 2 and 3.

Backed pieces

These are artefacts with abrupt retouch of one lateral, at right angles to the plane of the flake or blade. That this definition does not always hold good, and that it causes a division between the two types of borer are points that are discussed later in the report; but by and large it holds good for the artefact types included in this class.

Backed pieces account for 26,9 per cent of the retouched artefact category total and, although found in all layers except layers 15–13, are most common in layers 9–4, where individual layer frequencies exceed 24 per cent of the category total for the layer and reach a maximum of 41,3 per cent in layer 5.

In common with the other classes in the category, backed pieces are mostly silcrete (82,3% of the class total). Differences in the relative frequencies of the seven sub-classes listed in Table 7, as well as in raw material frequencies, indicate, however, the profitability of individual analysis of the sub-classes.

Backed scrapers (Fig 19) are the generally ellipsoidal artefacts otherwise known as 'double crescents' or 'double segments'. The name used in this report, although in some ways more accurately descriptive than the other terms, is not entirely satisfactory. While these artefacts almost invariably have 'scraper retouch' on one of the arcs, the retouch, or 'backing' on the other arc varies considerably in its angle. Strictly, 'backing' should be at 90° to the plane, but many of the backed scrapers have 'backing' at angles of 60° or less, which is more like scraper retouch, and these pieces would perhaps be more correctly termed 'double scrapers'. Also, on some of the pieces the modification of the arc opposite the backed arc is more like heavy utilization than deliberate retouch. However, these artefact types, despite the differences mentioned, are morphologically more like each other than they are like any of the other classes or sub-classes, and there seems no good reason for separating them.

As the various names for these artefacts imply, backed scrapers are typologically intermediate between segments and scrapers. They have the



Fig. 19. Backed scrapers, all silcrete except D, which is crystal quartz. A. Layer 1. B. Layer 2. C-E. Layer 4. F-I. Layer 5. J-L. Layer 6. M. Layer 7. N-O. Layer 8. P. Layer 9. Q. Layer 10. Stippled areas on J and K indicate mastic traces.

backed arc of segments but not their opposing chord, having instead a convex retouched edge like that of scrapers.

The fact that convex scrapers, segments, and backed scrapers all occur in the same assemblages suggests functional differences between the three types. Although metrical analyses were not undertaken, it is evident that backed scrapers fall within the size ranges of both the smaller convex scrapers and segments (cf. Figs 15, 19 and 20).

One of the pieces (Fig. 19N) is more like a 'chunky segment' (see *Segments* below), but has retouch on the ventral surface, unlike the others in the 'chunky segment' sub-class, which typically have retouch on the dorsal surface, as indicated in Figure 21. Two pieces (Fig. 19J–K) appear to have traces of mastic, as indicated by the stippling in the illustrations.

Sampson (1974, fig. 106) has suggested that backed scrapers are backed flakes that were jettisoned when their utility was exhausted. In view of the variability observed in the BNK 1 sample, this interpretation seems plausible. There seems, however, not enough of the gradation between these two classes of artefacts that might be expected in such a circumstance. It seems unlikely that only lightly utilized backed flakes and heavily utilized backed scrapers would remain on site. Also, as indicated in Table 7 and Figure 14, there seems an insufficient correlation between the frequencies of each type in the individual layers to provide support for Sampson's hypothesis. This is, however, a problem that could possibly be solved by replication studies.

Backed scrapers are a relatively small component of the retouched artefact category (7,4% of the site total), although they account for almost a third of the backed pieces. They are almost entirely (96,8%) made of silcrete, the remainder being quartz, with one of chalcedony. They were not found below layer 10 and are relatively common only in layers 6–4, in which 75 per cent of the site total were found. There is a marked falling off in frequency in layers 3–1 which suggests that, at BNK 1 at least, the popularity or utility of this artefact type was episodic. The ADs indicate the relative frequencies of these artefacts: that for layer 7 is 18; those for layers 6 and 5, 89 each; and that for layer 4, 37.

Segments (Figs 20–21), flakes or blades backed to form an arc opposed to a sharp-edged, unretouched chord, are the most common backed artefact in the assemblage (41,9% of the class total) and rank third in frequency in the retouched artefact category (Table 7). Although these artefacts are known from late Pleistocene assemblages (cf. Sampson 1974, table 32), there appear to be both temporal and geographic gaps in their distribution in Holocene deposits. In the BNK 1 sample, apart from four in layers 16 and 17, their occurrence is restricted to layer 12 and above, i.e. the last 8 000 years or so.

The segments are mostly silcrete (71% of the sub-class total) and the rest are quartz. There is some variation in the individual layers of the ratio of quartz to silcrete that is not simply related to the numerical fluctuations (Fig. 14). Ignoring layers 12, 11, 3, and 2, which contain five segments or fewer, the ratio

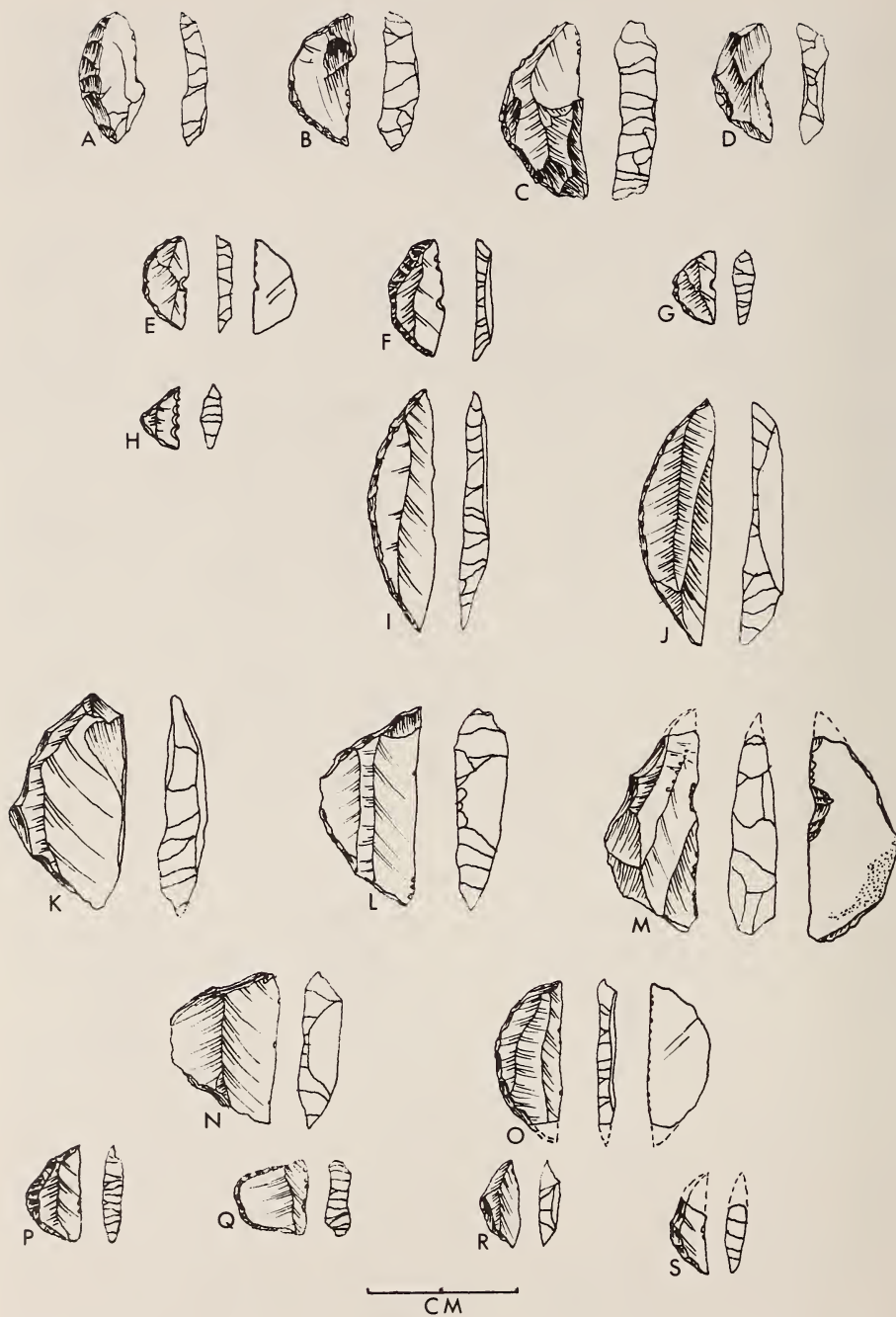


Fig. 20. Segments. A-D, F. Silcrete, layer 5. E, I-J. Silcrete, layer 9. H. Crystal quartz, layer 9. K-P, R-S. Silcrete, layer 6. Q. White quartz, layer 1.



Fig. 21. 'Chunky' segments. A-B. Silcrete, layer 4. C. Crystal quartz, layer 5. D-E, P. Silcrete, layer 5. F-H. Silcrete, layer 6. I-K. Silcrete, layer 7. L-M. Silcrete, layer 9. N-O. Silcrete, layer 10. Stippled areas on I indicate mastic traces.

of quartz to silcrete rises from 0:13 in layer 10 to 1:1,7 in layer 7, declines in layers 6 and 5 (1:6) and rises again from 1:1,3 in layer 4 to 5,8:1 in layer 1.

The trends in segment frequencies, regardless of raw material, are for an increase from layer 12 to layer 9, a decrease until layer 6, with an apparently anomalous increase in layer 5 followed by a decrease in layers 4 and 3 and increases in layers 2 and 1. (Fig. 14). The ADs for layers 9-4 are: layer 9, 71; layer 8, 76; layer 7, 51; layer 6, 44; layer 5, 87; layer 4, 25. This tends to support the trends indicated by the actual frequencies, and shows that the increase in layer 5 is not merely related to an increase in this layer's excavated volume.

Slightly fewer of the segments are made on blades than on flakes (44,7% of the site total), although in layers 10-7 segments made on blades are more common (52-64% of the layer totals).

A problem in the classification of segments is their tendency to grade into backed flakes. There was little agreement among those who worked on or examined the BNK 1 stone artefacts regarding marginal cases, and the allocation of these has been somewhat arbitrary. Another type that caused problems was the informally named 'chunky segment' (Fig. 21). These artefacts have coarse, broad retouch on the arc, and the possibility was considered that this might not be retouch at all, but that the artefacts might be a type of core rejuvenation flake struck obliquely from the end of a cylindrical (polar or blade) core and the 'retouch' no more than flake scars. However, the type of core from which such flakes might have been struck does not occur in the assemblage and these artefacts were accordingly classified as segments or backed flakes depending on the degree of resemblance to either type. It would perhaps be closer to the truth to say that those that looked less like segments were classed as backed flakes.

Intergrading between segments and backed scrapers was less of a problem since, although a few segments have utilization of the chord that is heavy enough to be called retouch, it does not extend the full length of the chord, nor does it cause the chord to assume a convex shape. There was no evidence from the site sample that prolonged utilization of segments might result in the double arc of the backed scraper.

Figure 22 presents graphically the results of metrical analyses of the dimensions of unbroken segments. These show that the mean size of quartz segments in any layer is lower than that of silcrete segments. Although quartz segments vary little in length in layers 9-7, those in silcrete show a diminishing trend. In layer 6 the mean length of both quartz and silcrete segments is highest for their respective raw materials, and from this layer up the segments tend to become shorter, although the quartz segments from layer 1 are on average no shorter than those from layers 3 and 4.

Secular trends are more evident in width. There is an increase in the mean width of both quartz and silcrete segments from layer 10 up. This reaches a maximum in layer 6, as is the case with length, so that the segments from this

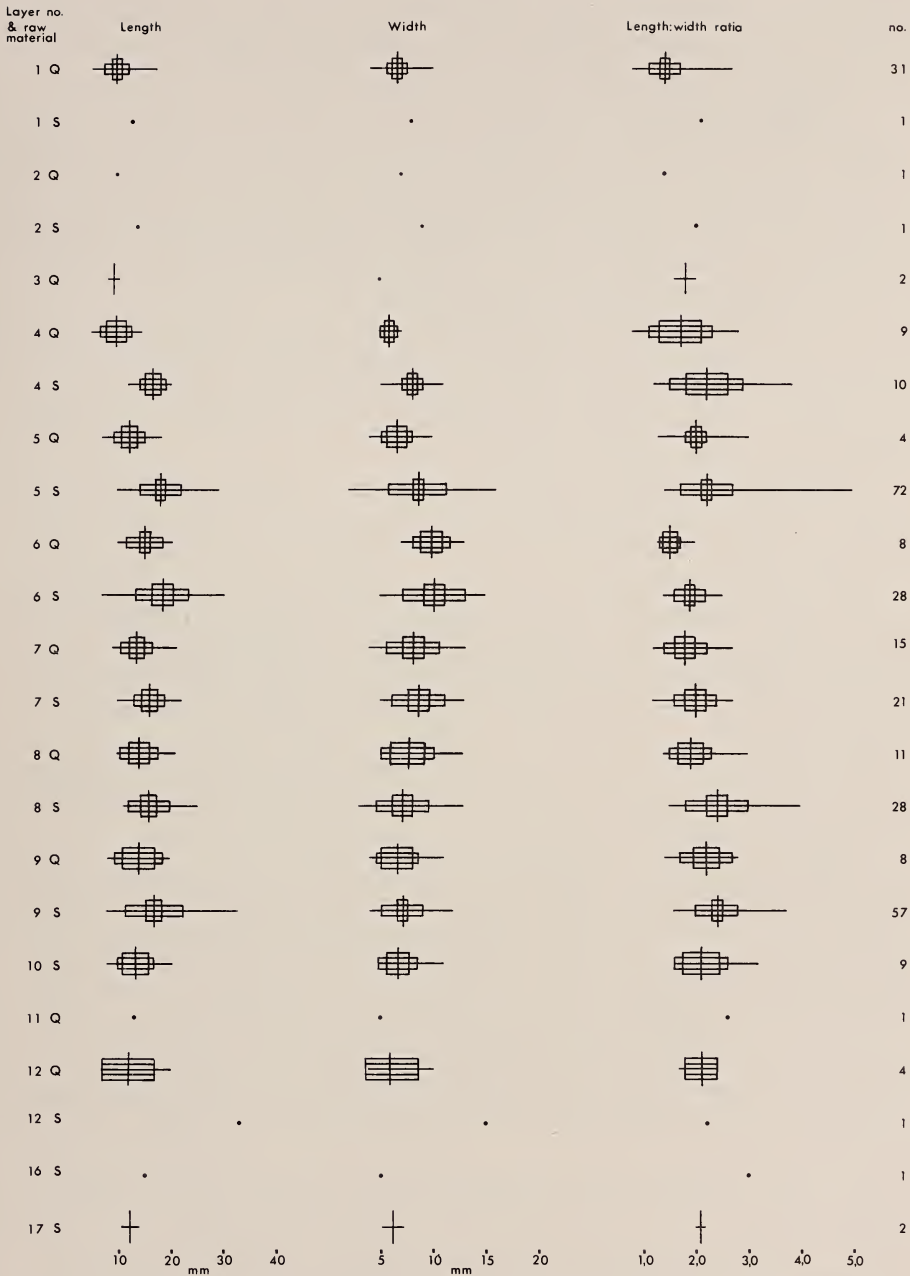


Fig. 22. Modified Dice-Leraas diagrams of segment dimensions and length:width ratios. Q = quartz, S = silcrete. Layer frequencies are given on the right. For details of symbols, see Figure 8.

layer are, on average, the largest in the sample. From layer 5 up the segments tend to become narrower, although the quartz segments in layer 1 are on average wider than those of layer 4 and about the same width as those of layer 5.

In shape, i.e. length:width ratio, there is a trend from a more or less equidimensional shape in layer 10 to a somewhat longer shape in the silcrete segments from layer 8, while the quartz segments from this layer indicate the trend that continues in the upper layers, towards a wider form that reaches its maximum in layer 6. Layer 5 has a somewhat anomalous reversion to a longer shape in the silcrete segments and an equidimensional shape in the quartz, but after this the trend towards a wider form continues.

These trends may be summarized as follows: quartz tends from a longer shape (2:1 ratio) in layer 12 to an equilateral shape (1:1 ratio) in layer 6, reverting to a somewhat longer shape (1,5:1 ratio) in layers 5, 4 and 1; silcrete tends from a longer shape (2:1 ratio) in layers 10–6 to a slightly longer shape (nearer 2,5:1 ratio) in layers 5 and 4.

Fifty-three segments (13,5% of the site total) appear to have traces of mastic. As it was observed that most of the segments (376, being 95,7% of the site total) show utilization of the chord a more intensive analysis of these was undertaken by D. Halkett.

Of the 17 segments that show no traces of utilization, 13 are silcrete, 3 white ('milky') quartz and 1 crystal quartz. Since it is only on white quartz that utilization is difficult to detect, it is reasonable to assume that at least 14 of the segments were not utilized. This is supported by the fact that 46 of the 111 utilized quartz segments were white quartz, showing that it is possible to recognize utilization even on this raw material. Broken artefacts (87) were excluded from the analysis as being incapable of providing complete information regarding the extent and placement of utilization.

Results of Halkett's analysis are given in Table 8. Two main groups, unifacially and bifacially utilized, were recognized. Unifacially utilized segments account for almost 70 per cent of the sample total and could be divided into four types, each subdivided according to whether the flake scars resulting from utilization are on the dorsal or ventral surface. To counter the suggestion that type 3 is merely an inverted version of type 1, it must be pointed out that when dorsal and ventral surfaces are taken into account such an inversion is not possible. To further obviate the possibility of error the segments were sorted according to graphic convention, with the dorsal surface up and the arc facing left.

The most common type of unifacial utilization is along the whole length of the chord (type 4, 41,5% of the group total), and in this type utilization on the dorsal surface exceeds that on the ventral surface by a factor of 2:1. The ranking of the other three types, in order of frequency, is type 1 (26%), type 3 (23,2%), and type 2 (9,2%). In each case the frequency of segments with utilization on the dorsal surface exceeds that of utilization on the ventral surface. (It must be stressed that it is the term 'utilization *on*' that is used, not

TABLE 8

Stone: analysis of utilization types of segment chords.

Class: Type: Surface:	unifacial								bifacial			
	1		2		3		4		5a	5b	6	7
	D	V	D	V	D	V	D	V				
Layer												
1.....	9	3	3	1	2	—	5	3	2	2	—	—
2.....	—	—	—	—	—	—	—	1	1	—	—	—
3.....	1	—	1	—	—	—	—	—	—	—	—	—
4.....	1	—	—	1	3	—	5	5	1	1	1	1
5.....	5	4	5	4	5	10	15	5	5	7	8	5
6.....	2	1	1	—	2	2	9	4	1	8	1	1
7.....	4	—	—	—	5	3	9	1	2	2	3	3
8.....	3	4	—	—	4	2	5	3	3	2	4	2
9.....	8	3	2	1	2	6	6	5	4	8	3	6
10.....	3	1	—	—	1	—	—	1	1	1	—	—
11.....	—	1	—	—	—	—	—	—	—	—	—	—
12.....	1	—	—	—	1	—	2	—	—	—	1	—
16.....	—	—	—	—	—	—	1	—	—	—	—	—
17.....	—	—	—	—	—	—	—	1	—	—	—	—

Description of types (position of utilization):

unifacial: type 1—upper only; type 2—middle only; type 3—lower only; type 4—whole length.
(D = dorsal surface; V = ventral surface)bifacial: type 5a—upper dorsal and lower ventral; type 5b—lower dorsal and upper ventral;
type 6—whole dorsal and upper/lower ventral; type 7—whole length, dorsal and ventral.

‘utilization of’. The use of the term indicates the surface on which the bulk of the flake scars are visible.)

Of the 90 segments with bifacial utilization the most common are type 5b (34,4% of the group total), while frequencies of the other three types are similar (20,0–23,3%). Types 5a and 5b are considered variants of one type because when both surfaces show utilization it is less certain that one subtype is not an inverted version of the other than is the case when the artefacts show only unifacial utilization. The utilization patterns of types 5a and 5b could result from reversal of the segment during the period of its use.

If the bifacially utilized segments are considered as artefacts that have been used more than once and their utilization patterns are combined with those of the unifacially utilized segments, two major utilization modes can be recognized, and one minor:

mode 1: utilization of the end only (54,7% of the total), types 1, 3, 5 (a and b), 6;

mode 2: utilization of the whole chord (39,3%), types 4, 6, 7;

mode 3: utilization of the middle only (6,0%), type 2.

Type 6 is included in both modes 1 and 2 since the type of utilization on each surface falls into a different mode.

Halkett's examination of the segments with traces of mastic did not allow him to reach firm conclusions regarding the relationship between the area apparently covered with mastic and the utilization of the chord. There were too few artefacts on which the mastic traces were sufficiently well defined for the area covered by the mastic to be determined with any confidence. The indications seem to be, however, that where the mastic was at an angle to the chord and did not cover the whole of the arc, utilization was restricted to the end (mode 1). Where the mastic was parallel to the chord and covered the arc, utilization was usually of the whole chord (mode 2). In the seven cases where the middle only was utilized (mode 3) the mastic appears to have been parallel to the chord, as in mode 2. There was, however, one case where the mastic appears to have covered only about a third of the length of the segment.

A segment from layer 6 (Fig. 20M) is somewhat anomalous in that it combines more than one of the utilization modes described above. It has dorsal utilization on the lower half of the chord and ventral utilization on the upper half, which also includes a trimmed notch. Mastic traces on the lower ventral surface extend on to the arc and suggest that this was not completely covered by the mastic. Wear of the transverse flake scars on the dorsal surface adjacent to the utilized and notched part suggests that the utilization on the upper part of the ventral surface of the chord resulted from a 'push-plane' type of action in which the dorsal surface was abraded by contact with the artefact (?) the segment was being used to work.

Although it would be necessary to carry out replication tests in order to support any assumptions derived from the study of the utilization modes and mastic traces where the latter exist, it seems clear from Halkett's analysis that segments were not all used in the same way. The implication of this is that they were not all used for the same purpose, and possibly that some were used for more than one task.

Clark (1959, fig. 29) and Phillipson (1976: 140) have provided examples of how segments, amongst others, might have been hafted. The variety of the positions and, in the case of Phillipson's examples, the range of shapes, would go some way towards explaining utilization modes 1 and 2 but not mode 3, but they do not explain why utilization on the BNK 1 segments is more commonly unifacial.

If a cutting or scything action were employed, chipping on both ventral and dorsal surface could be expected, but unifacial utilization scars seem to indicate the application of pressure on one side of the chord, such as might be used in a unidirectional scraping or paring technique in which the segment was held parallel or at an acute angle to the surface of the object being worked. Halkett (1979 pers. comm.) is of the opinion that utilization of the whole segment chord would be consistent with hafting of the type in Phillipson's examples 3-8, and utilization of the ends only with Phillipson's examples 1 and 2. Utilization that produces only unifacial damage to the chord seems, however, contrary to Phillipson's suggestions of use as transverse arrowheads or 'for pressure-cutting rather than impact cutting or scraping' (Phillipson 1976: 218).

Clarke (1979, figs 1–2) has illustrated twenty-two hafted composite tools set with microliths and microblades. Seven of these are based on ethnographic models and the others on archaeological finds in Mesolithic contexts. While not all forms are appropriate to segments, they serve to illustrate the wide range of hafts in which segments and similar artefacts could have been mounted, and which would have produced different edge-wear patterns. They also serve to remind that morphologically different artefact types need not necessarily be restricted to different types of tools and functions.

The problem, in a southern African context, is that there is virtually no evidence, archaeological or ethnographic, for the use of hafted implements of the types illustrated by the authors previously mentioned. J. Parkington has shown one of the authors (M.L.W.) an artefact from De Hangen, which is a lump of mastic in which a segment has been mounted so that it projects at an oblique angle in such a way as to suggest its use as a cutting or graving tool. The mastic-mounted quartz artefact from Die Kelders layer 12 (Schweitzer 1979, fig. 37) was considered as possibly being one of the short and wide '*petit tranchet*' type of segments (Fig. 20H, Q), but X-ray photography of the artefact failed to produce an image clear enough to substantiate this.

The seven glass-tipped arrowheads and an eighth tipped with either crystal quartz or glass that were made in 1878 for Dr W. H. I. Bleek by the Bushman Jantje, and of which an example was illustrated by Goodwin (1945, fig. 2) do not have segment-shaped tips. It seems doubtful in any case whether the segments from BNK 1, even if mounted in the manner illustrated by Goodwin, would have been effective as arrowheads: they are not notable for having sharp tips, and in many cases the junction of chord and arc hardly forms a point at all (cf. Figs 20–21).

Three unusual types of segment must be mentioned, although they are too few to warrant separate classification.

1. *Notched*. Seven segments, from layers 1, 5–6, 8–9, have a notch in the centre of the chord (Fig. 20E–G, M). The segment from layer 6 has already been mentioned; those from layers 1 and 5 have type 5b utilization, that from layer 8 and one from layer 9 have type 5a, and the remaining two, also from layer 9, type 4. The notch is thus apparently not directly associated with a particular type of utilization. It might have been accidental, although the notch on the layer 6 segment is not a single flake removal but the result of repeated chipping. The notch may have been made to facilitate securing the segment to its haft by means of a thong.

2. *Flanged*. The five segments of this type are from layers 1, 5 and 12, and are illustrated in Figure 20A–D, but most notably B and D; also Figure 21G. The flange is not a fracture of the chord after the flake was struck from the core since the whole of the chord, including the flange, has a sharp edge. Four of the segments have type 4 utilization and the fifth, from layer 5, type 7. These segments thus show a common pattern of utilization of the whole length of the

chord, which suggests that the presence of the flange may have been irrelevant to the artefact's function.

3. *Denticulate*. Two very small segments, 7 mm and 8 mm long, were recovered from layers 9 and 12. That from layer 9 is illustrated in Figure 20H. Both are made of crystal quartz and the notches in the chord are too deep and too regular to be the result of utilization similar to that which caused the edge-wear on the bulk of the sample. The regularity of the notching suggests that the denticulation was a deliberate effect, but the function of such small saw-edged artefacts can only be guessed at.

Trapezoids are parallel-sided flakes or blades with their ends backed obliquely to the length of the piece to produce a trapezoidal shape (Fig. 23A-M). They differ from the sub-class of obliquely backed pieces (see below) in that the latter have only one end backed while trapezoids have both. Whether this difference represents a 'real-life' difference or merely a typological one is a matter that cannot be determined, since the function of these artefact types is not known.

Trapezoids were found only in layers 9-5, with the highest frequency (six) in layer 9. Four, possibly six, are made on blades, the rest on flakes. The four made on blades have utilization flake scars on the dorsal surface of the longer lateral and on the ventral surface of the shorter, but the utilization on the other pieces cannot be so clearly determined, beyond the fact that it is always on the longer lateral. One piece (Fig. 23C) has a notch as well as utilization, and on three others the utilization is on both surfaces of the edge and appears to be more consistent with the use of the artefacts for cutting rather than scraping, although this is not altogether certain.

One trapezoid (Fig. 23E) is made of a fine-grained quartzite, and the rest are all silcrete.

Obliquely backed pieces, abbreviated to 'obliques', are flakes (twenty-one) or blades (six) that have one end truncated by backing at an angle oblique to the length of the piece (Fig. 23N-P). Apart from one in layer 19, these artefacts came from layer 11 and above.

All the pieces show utilization of the edge, 14 on the ventral surface, 8 on the dorsal, and 3 on the dorsal surface of one edge and the ventral surface of the other. On the remaining 2 pieces the utilization is restricted to the upper part of the edge, adjacent to the truncation (Fig. 23P). This utilization is of the type found on backed points (see below).

All the artefacts were made of silcrete except for one of crystal quartz and one of chalcedony.

Backed flakes are a morphologically heterogeneous group, of which the common factor is that all the pieces are wholly or partly backed along one edge. As indicated in Figure 13, backed flakes intergrade with scrapers, backed scrapers (to a lesser extent), segments, backed points (borers) and inevitably, 'miscellaneous retouch'. In the same way that the class of 'miscellaneous retouch' consists of pieces that cannot readily be included in any of the more



Fig. 23. A-M. Trapezoids. N-P. Obliquely backed pieces. All silcrete except E, which is quartzite. A-C. Layer 5. D. Layer 6. E-G. Layer 7. I-M. Layer 9. N. Layer 4. O. Layer 6. P. Layer 8.

formally definable classes, so the sub-class of backed flakes contains those artefacts that cannot be allocated to other classes, although it seems quite likely that they do represent a validly distinct group in terms of function if the shape of the more formally definable classes is related to function and not merely to style. However, the fact that the artefact classes do intergrade provides the principal reason for the avoidance in this report of the term 'formal tools'.

As mentioned previously in the discussion of backed scrapers, Sampson (1974, fig. 106) has suggested that backed flakes, by the time their utility has been exhausted, may take the form of backed scrapers. In the BNK 1 sample backed scrapers outnumber backed flakes by about 2:1 and there is a lack of intermediate forms—heavily utilized backed flakes—that would be expected if Sampson's suggestion were correct, since it seems unlikely that only moderately utilized pieces and worn-out discards would be found. Also, very few of the backed flakes in the BNK 1 sample have a backed lateral that is convex, a prerequisite for backed scrapers.

Backed flakes account for 14,9 per cent of the backed artefact class and 4,2 per cent of the retouched artefact category. Apart from two in layer 18, their distribution is restricted to layer 12 and above, with maximum frequencies in layers 9–5, although these are never high (Fig. 14, Table 7). Silcrete is again the most common raw material (88,5% of the site total), with a low frequency of quartz (10,8%) and only one piece in quartzite.

The backing is variable, in some cases covering the whole of one lateral, in others less than half. Apart from seventeen pieces, all probably broken, the backing is opposed to a sharp edge that in all but four cases shows signs of utilization. Among the utilized pieces are four that would have been classed as backed points (borers) but for the fact that the utilization covers all, or almost all, of the edge, a characteristic not consistent with the functional implication of the name 'borer' and not to be found on the artefacts included in the latter sub-class. In some cases the retouch is not at right angles to the plane of the flake, and this caused some doubt as to whether these pieces should not be classed as scrapers. They were, however, less like the bulk of the scrapers in the sample, variable though these are, and were therefore included with the backed flakes.

Backed blades, of which there were only seventeen, form a negligible part of the backed artefact class (1,8% of the site total) and the retouched artefact category (0,5%). Apart from two in layer 19, their distribution was restricted to layer 10 and above. Fifteen of the blades are silcrete and two, from layers 4 and 1, are quartz.

All but one of the blades are broken and it has not been possible to classify them with any confidence in the way that H. J. Deacon (1976, fig. 61) has done with the blades from Highlands Rock Shelter. However, the width of the blades suggests that most would fall into the 'bladelet' size class (15–25 mm long).

Thirteen blades have utilization of the unretouched lateral. Six have unifacial utilization, 2 with flake scars on the dorsal surface, 4 on the ventral. The remaining 7 blades have bifacial utilization of a kind that suggests their having been used for cutting rather than scraping. Two that could be considered to fall into Deacon's class of backed points (H. J. Deacon 1976, fig. 61F and G), but not into the BNK 1 class of backed points (borers) (see below), have bifacial utilization, while a third shows utilization on the dorsal surface only.

Borers

The artefacts in this class are of two types, here termed points and drills. Points are included in the class of backed pieces and cover a range of forms whose common attribute is backing of part or all of one, sometimes both, of the laterals to form a sharp or tapered point (Fig. 24A–F). Drills, on the other hand, are pieces that are often cylindrical in shape and have a blunt end (Fig. 24G–I). The retouch used in the making of drills cannot be called ‘backing’ in the sense that has been applied to the backed artefacts in this report, and drills have accordingly been excluded from the class of backed pieces.

There seems little doubt that drills do form a typologically distinct class that might also be valid in terms of the artefacts’ function, whatever that might have been. Points, on the other hand, like scrapers and backed flakes, are a morphologically heterogeneous group united by a common type of retouch.

Microscopic examination of the backed points failed in most cases to reveal clear evidence of utilization, but it appears from some of the artefacts, particularly those made of crystal quartz, that there is utilization of the tip that is consistent with the artefact’s presumed function as a boring tool. However, in many cases the utilization appears to cover more of the unretouched lateral than is consistent with boring unless holes were being bored that had diameters equal to the greatest width of the artefact in the part utilized. It is, of course, possible that these artefacts served more than one purpose, as seems to have been the case with other artefact types.

Some of the backed points are similar to those classed by H. J. Deacon (1976, fig. 61) as ‘backed points’ (types F and G) or ‘unsegmented blanks’ (type K), as well as the unnamed types B and C. In the BNK 1 sample there were three from layer 1 and eleven from layer 5. They are in the same size range as those illustrated in Figure 24B–C but are only 2–3 mm wide at the base.

The distribution of points and drills is similar (Fig. 14, Table 7), although there are more drills than points in layer 4 and the opposite in layers 2 and 1. Points account for 3,3 per cent of the retouched artefact category and drills for 3,1 per cent. Both types are numerically most common in layer 5, in which points are also relatively most common (6,2% of the retouched artefact category total) while drills are relatively most common in layer 4 (5,8%).

Silcrete is the most common raw material, accounting for 80,7 per cent of the total number of points and 91,3 per cent of the drills. Of the 19 quartz points, 3 are in layer 2 and 9 in layer 1, which is consistent with the increasing use of this raw material in layer 1 (Fig. 7, Table 3). There is only 1 quartz drill, also from layer 1. There are 3 chalcedony points and 8 drills.

Notched flakes

These were found in sufficient quantity to warrant their separate classification in Table 9. They were found throughout the sequence except layers 16 and 14, but are more common from layer 9 up, where they account for 84,6 per cent of the site total. Silcrete is again the most common raw material (76,9% of the

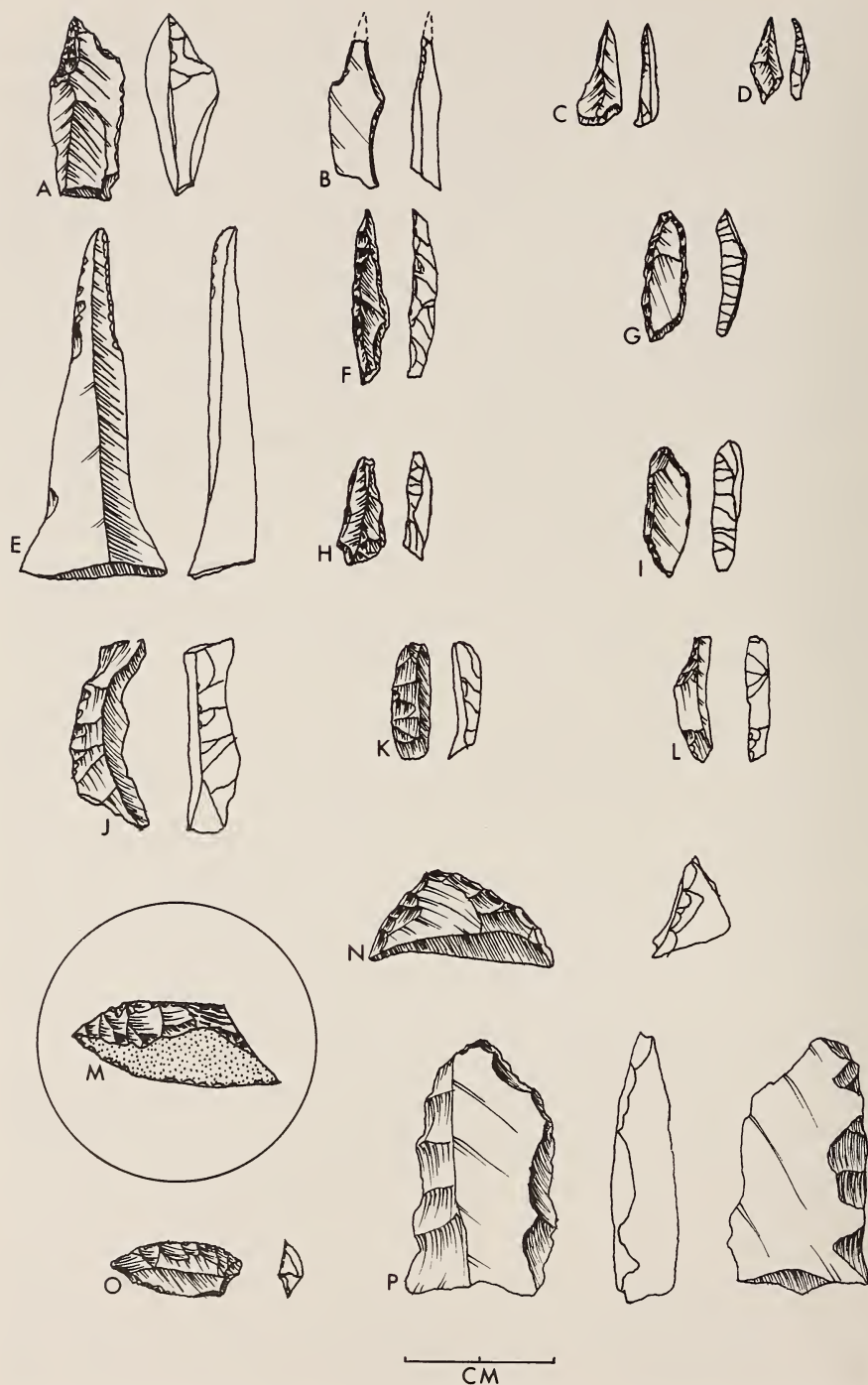


Fig. 24. A-E. Borers (backed points). F-I. Borers (drills). J-L. 'Scraper rejuvenation flakes'. M-P. Miscellaneous retouched pieces. A-B. Silcrete, layer 1. C-D. Crystal quartz, layer 1. E-J. Silcrete, layer 5. K. Silcrete, layer 6. L. Silcrete, layer 9. M. Quartz, layer 13 (twice natural size; stippled area indicates mastic traces). N-O. Silcrete, layer 7. P. Silcrete, layer 5.

TABLE 9
Stone: inventory of types of notched flakes.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Type 1: single, side	2	—	1	2	4	6	2	1	5	—	—	—	—	—	1	—	—	1	1	26
2: single, end	1	—	—	—	1	—	—	1	2	1	—	1	—	—	—	—	—	—	—	7
3: double, large	2	—	—	2	2	1	1	—	1	—	—	—	—	—	—	—	—	—	2	11
4: denticulate	3	2	—	3	4	—	2	—	4	—	1	—	1	—	—	—	1	—	—	21
Total	8	2	1	7	11	7	5	2	12	1	1	1	1	—	1	—	1	1	3	65

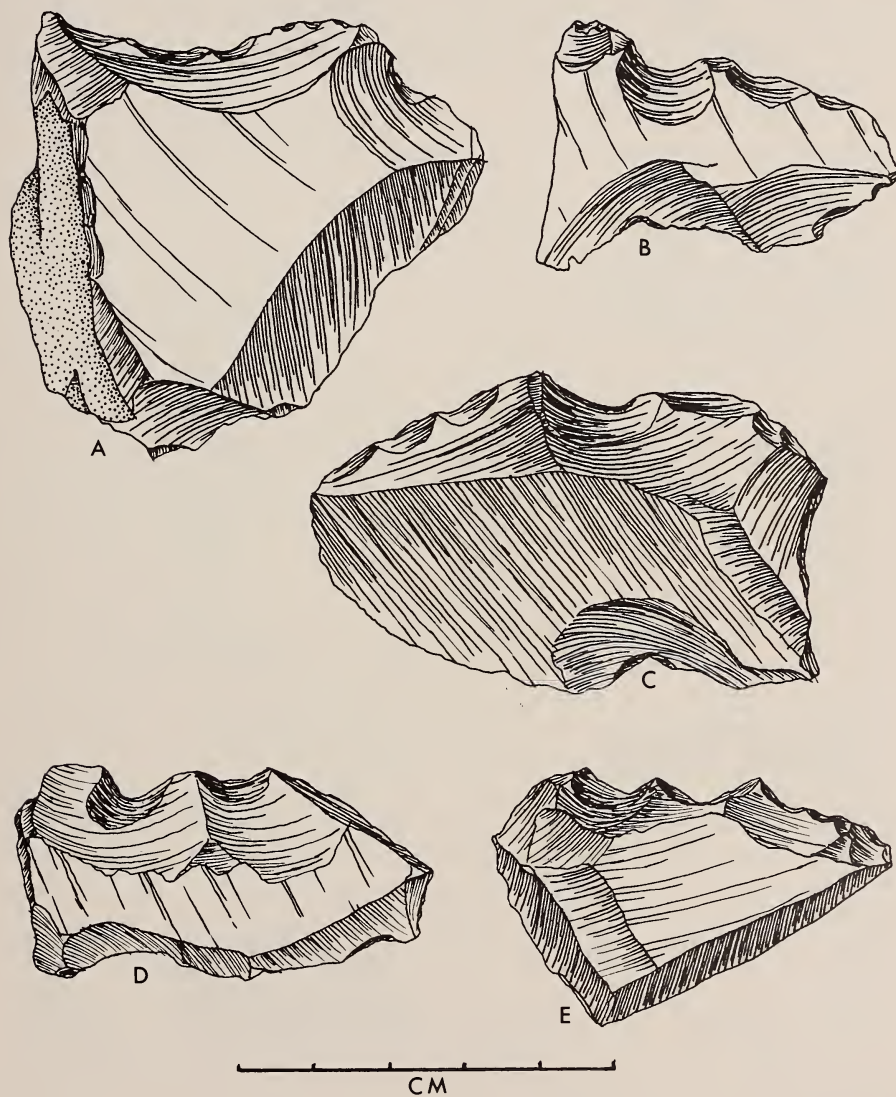


Fig. 25. Notched flakes. A, C. Quartzite, layer 5. B. Quartzite, layer 17. D-E. Quartzite, layer 19.

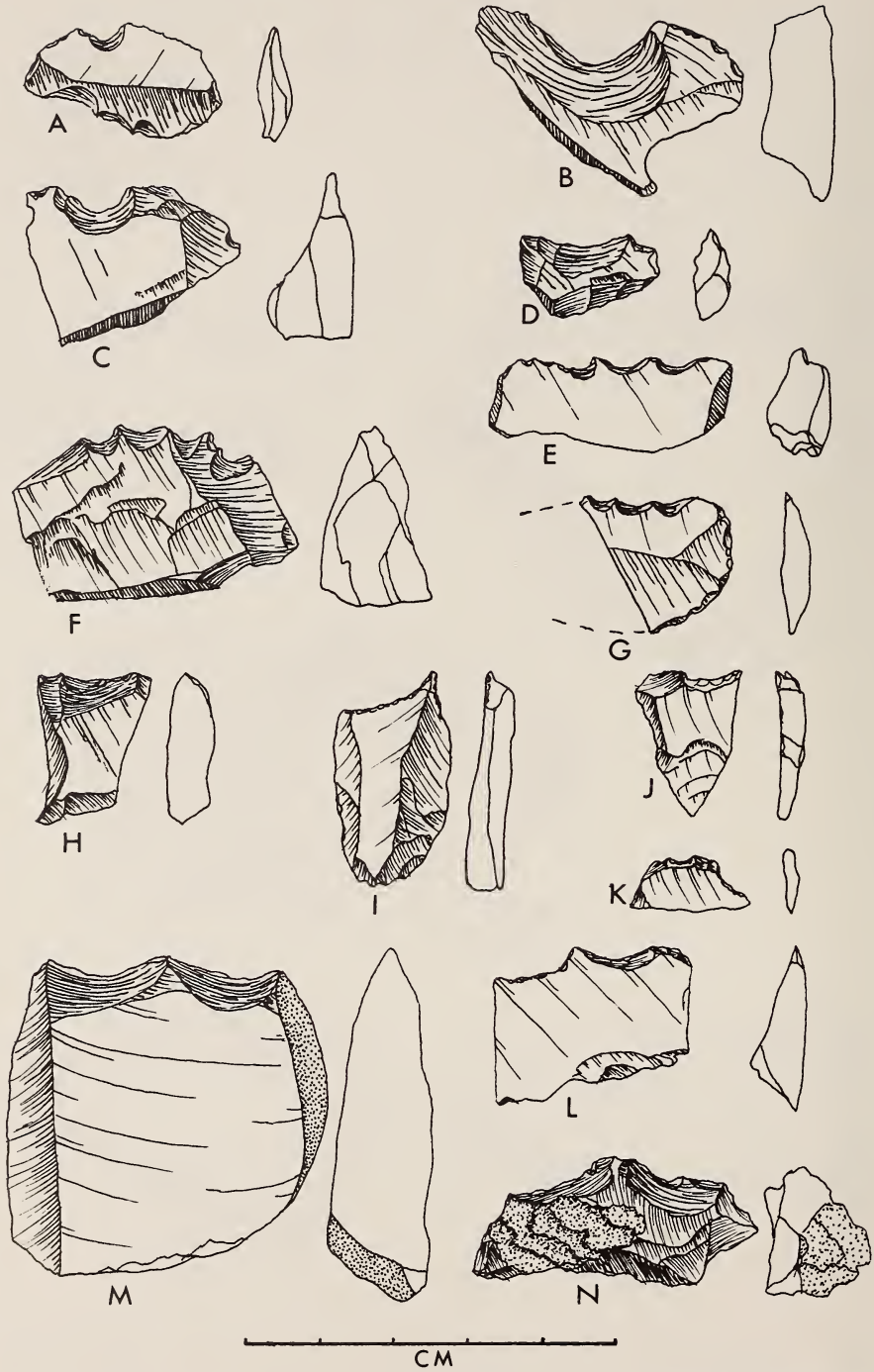


Fig. 26. Notched flakes. A, C, G, I, K. Silcrete, layer 9. B, H. Quartzite, layer 9. E. Silcrete, layer 11. F, J. Silcrete, layer 5. D, M. Silcrete, layer 1. L. Quartzite, layer 1. N. Silcrete, layer 4. Stippled areas indicate cortex.

class total), followed by quartzite (16,9%), the remainder being three of quartz and one of limestone. As indicated in Table 9, the notched flakes have been divided into four types, which are described below.

Type 1 (Fig. 26B–D, K) has a single, deep notch on the side. In most cases the notch is on one side only, but 3 pieces have a notch on both sides. In 5 cases the notch results from a single flake removal but in the rest it is the result of repeated flaking not unlike that on adzes; 18 are silcrete, 7 quartzite and 2 quartz.

Type 2 (Fig. 26H–J) has a large, wide notch at the end of the flakes rather than on the side, and in all cases the notch is the result of step-flaking. All the artefacts are silcrete.

Type 3 (Fig. 25A–E, Fig 26L–N) has a large, wide notch on either the side or the end; 6 pieces have two adjacent notches (e.g. Fig. 26M) but 4 smaller pieces have only one; 6 are silcrete and 4 quartzite.

Type 4 (Fig. 26A, E–G) are denticulates, with two or more adjacent notches. There was some doubt as to whether the double-notched pieces should not be assigned to type 3, but the size of the notches is very different, and the artefacts were sorted on the basis of the size of the notches rather than their number; 16 of the pieces are silcrete, 2 quartzite and 1 quartz.

The division of the notched flakes into types is not absolute and is not intended to do more than indicate the variety in the BNK 1 sample. As is the case in most of the artefact classes, the division between types is not clear-cut and classification is thus somewhat arbitrary. Frequencies of the four types are too low for statistical analysis, and there are no evident secular trends, as indicated in Table 9.

Miscellaneous retouch

As its name implies, this is an informal class of retouched artefacts that cannot readily be assigned to any of the typologically more cohesive classes dealt with above. As indicated in Figure 13, there is an intergrading between the artefacts of this class and utilized flakes, scrapers, backed flakes and borers (backed points); and it is probably true to say that this class consists in the main of 'rejects' from the other classes.

There are, however, two types that can be classified separately but have been included here because their frequencies are too low to warrant separate classification. For purposes of this report these two types have been given *informal* names, and these are used reluctantly because of the ease with which informal terms tend to become formal. The frequencies of the types are given in Table 10.

'*Planes*' (Fig. 27) are artefacts that have a retouched (or heavily utilized) edge at the junction of a flat base and a relatively steeply angled upper surface. In almost all cases the flaking has produced a straight or slightly convex edge which is denticulated in a number of cases. This is, however, very different from the well-defined notching of the denticulate notched pieces (Fig. 26).

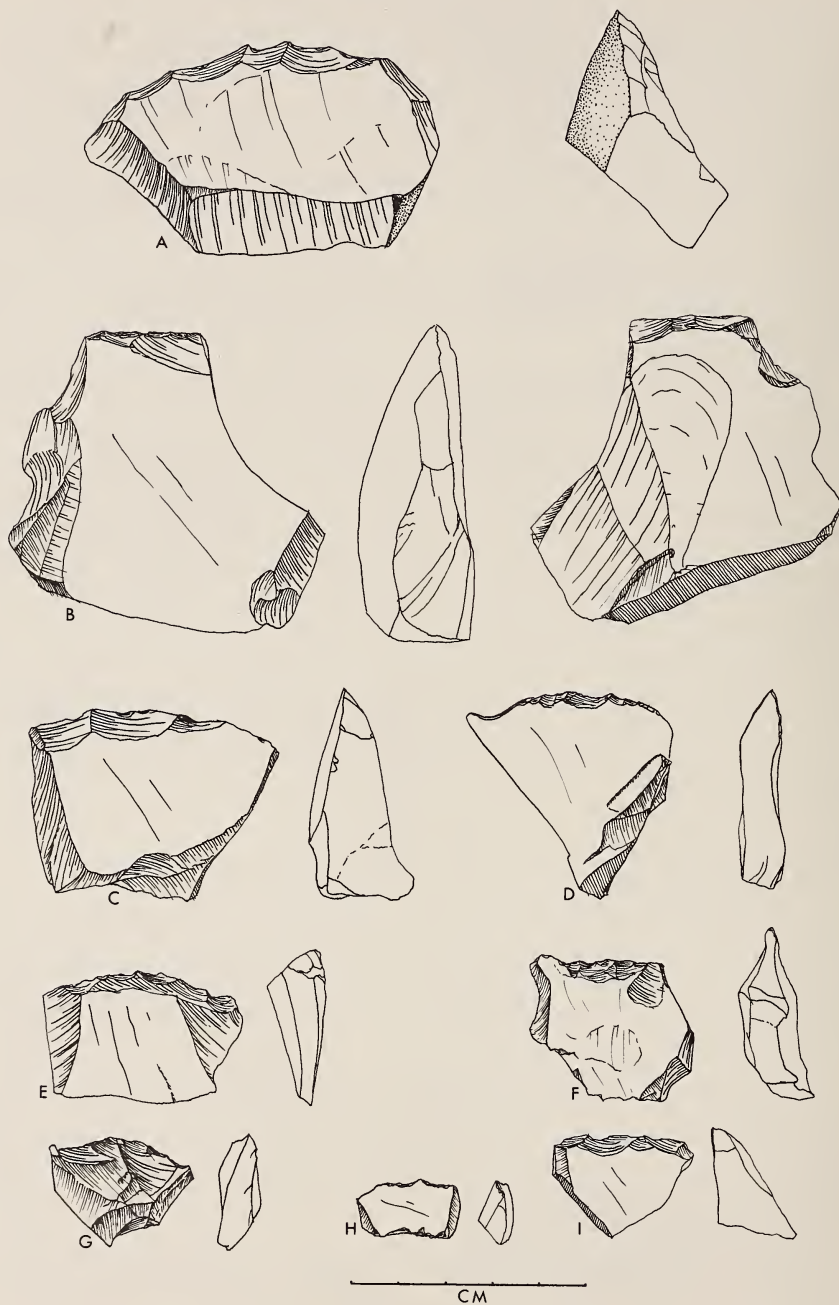


Fig. 27. Miscellaneous retouched stone artefacts: 'planes'. A. Quartzite, layer 3. B. Limestone, layer 9. C. Quartzite, layer 4. D. Quartzite, layer 18. E. Quartzite, layer 9. F. Quartzite, layer 12. G. Silcrete, layer 10. H. Silcrete, layer 7. I. Quartzite, layer 15.

TABLE 10

Stone: inventory of sub-classes of miscellaneous retouched artefacts.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
'Planes'	1	—	1	1	1	1	1	—	2	2	1	3	—	—	1	—	—	1	1	17
'Cutters/scrapers'	—	2	—	1	—	1	1	1	—	—	—	1	—	—	—	—	—	—	3	10
Other	4	1	1	5	7	9	9	8	8	1	5	1	1	—	—	—	1	1	—	62
Total	5	3	2	7	8	11	11	9	10	3	6	5	1	—	1	—	1	2	4	89

These artefacts are unlike the 'extra large' scrapers (Fig. 16), especially in having a flat base that suggests their having been held at 45° from the horizontal plane, or more.

'Planes' were recovered from thirteen of the layers, but because frequencies are so low their absence from the other layers, as well as their relatively increased frequency in layers 12, 10 and 9 cannot be seen as significant; 10 of these artefacts are quartzite, 6 silcrete and 1 limestone. The silcrete pieces are from layers 12, 10, 7, and 1 and the limestone artefact is also from layer 10.

'Cutters/scrapers' (Fig. 28) are in some ways similar to 'planes' except that they are generally fairly flat pieces with a straight, retouched edge that suggests the use of the artefact for cutting and/or scraping. They do not fit into the scraper class (Figs 15–16), and only two or three could reasonably be called 'knives' (e.g. Fig. 28B). Seven are silcrete, three limestone and, as indicated in Table 10, they are sporadically distributed through the sequence.

Other miscellaneous retouched pieces, which resist classification, make up almost 70 per cent of the class total (Table 10). Some of them are probably broken pieces and there are four that may be broken scrapers, although they look as if the retouched edge of the scraper flake had been removed deliberately by striking the flake parallel to its worked edge (Fig. 24J–L). In Figure 24 the three illustrated are informally termed 'scraper rejuvenation flakes'.

All but one of the miscellaneous retouched pieces are silcrete, and it is the single quartz piece that is perhaps most worthy of mention. Illustrated in Figure 24M, it is a small (13 × 5 mm) ellipsoid that in section forms a quadrant. The artefact is broken at one end and was probably originally 15 mm long. It may also be a piece broken from a larger artefact such as a (convex) scraper or a backed scraper, but whether the radii of the quadrant represent parts of a break cannot be determined. Half the artefact is covered by mastic, but the indications are that the whole of the surface forming the arc may be finely flaked, rather in the manner of a 'Still Bay' or Solutrean point.

This artefact was recovered from layer 13 and a similar but larger artefact in silcrete was recovered from layer 7 (Fig. 24O). This piece has a flat ventral surface and what appears to be a break at the bulbar end is, in fact, retouched. Neither of these artefacts can readily be included in the scraper or backed scraper classes.

Two other examples of miscellaneous retouched pieces are illustrated in Figure 24N and P to indicate the varying nature of the artefacts in this class.

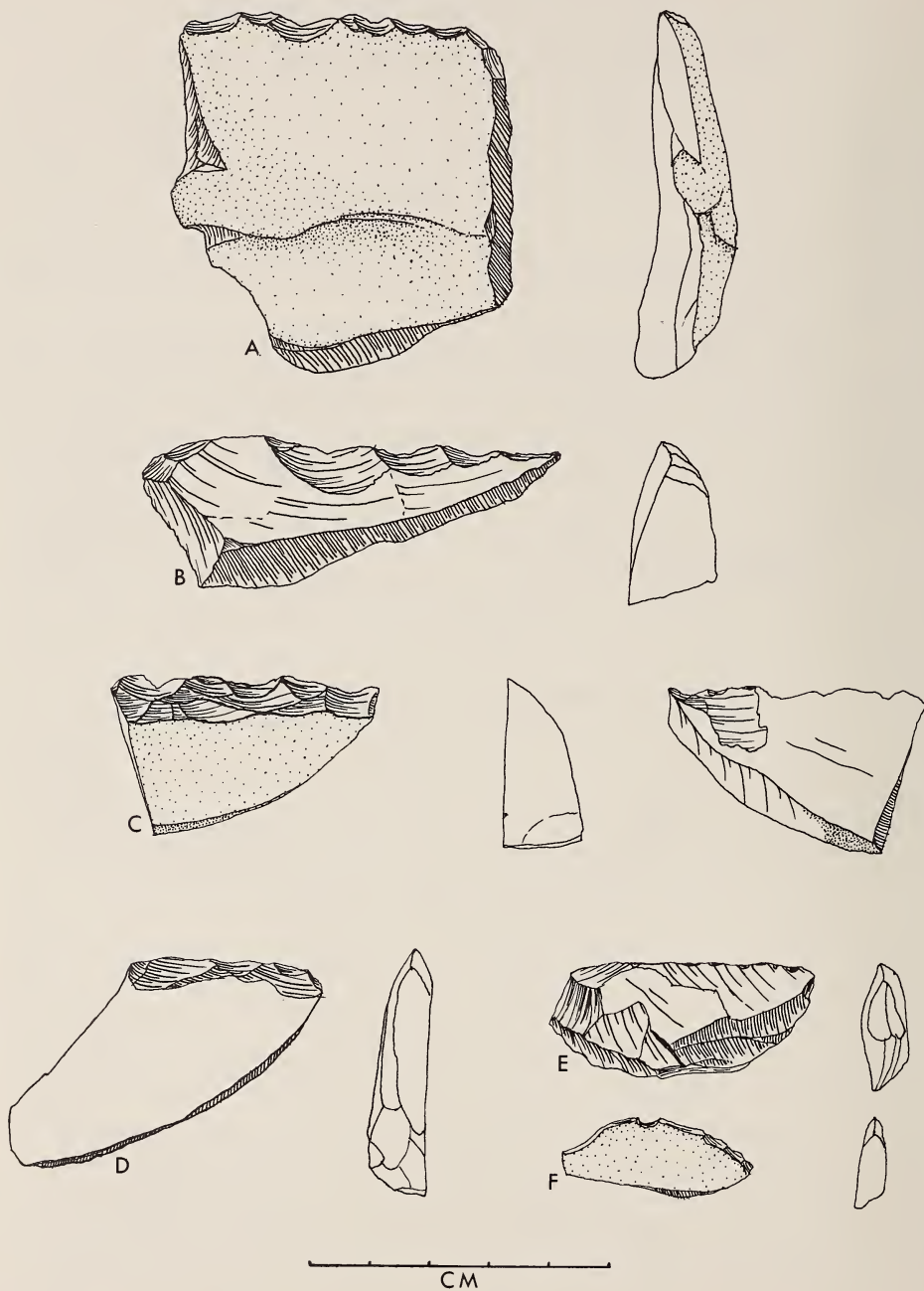


Fig. 28. Miscellaneous retouched stone artefacts: 'cutters/scrapers'. A. Limestone, layer 10. B. Quartzite, layer 7. C. Limestone, layer 2. D. Limestone, layer 8. E. Quartzite, layer 19. F. Quartzite, layer 1.

Middle Stone Age artefacts

These were recovered from layers 1, 5–6, 9, 12, and 19, layers 1 and 5 each yielding two pieces, the rest one. These are clearly *objets trouvés* and do not call for special comment as it is not uncommon for M.S.A. artefacts to be found in L.S.A. deposits, and there is no indication that the artefacts from the BNK 1 deposits have been reworked, as is sometimes the case. It might be of interest to compare these with the artefacts from the M.S.A. deposits at Die Kelders (Schweitzer 1979: 106), which might have been their source.

DISCUSSION OF THE STONE ARTEFACTS

Perhaps the most obvious fact about the BNK 1 stone artefact sample is that there is a marked difference between the contents of the lower layers and the upper. However, as the various inventories indicate, this difference is more quantitative than qualitative and there is no clear division, with changes taking place throughout the sequence.

All the classes of unmodified as well as utilized or modified artefacts are present in both groups of layers, and only one sub-class of the retouched artefact category, backed trapezoids, is absent from the lower layers. This seems to suggest a lower level of activity in the cave prior to about 6 000 B.P., possibly related to a lower intensity of occupation, rather than a subsequent increase in the *range* of activities carried out in the cave.

Further study of the artefacts and inventories suggests that it may be possible to isolate various stages or phases in the lithic technology of the cave occupants. Layer 19 is characterized by a relatively high frequency of artefacts (AD = 17 169), mostly unmodified, and with the highest frequency of all the layers of unmodified blades and blade cores. This is an aspect characteristic of the 'Robberg industry' as defined by J. Deacon (1978: 100), as is the high frequency of quartz relative to other raw materials. Other characteristics of the 'Robberg' are said by Deacon to be the generally higher proportion of small rather than large scrapers, and the presence of 'backed tools'. In the BNK 1 sample, however, the few scrapers tend to be medium rather than small (Fig. 17), and backed artefacts are present in all the layers except 15–13 (Table 7). Layer 19 is chronologically comparable with the uppermost unit of the 'Robberg' at Nelson Bay Cave (J. Deacon 1978, figs 2–3) but younger than those at Melkhoutboom (H. J. Deacon 1976, table 3).

From layer 19 to layer 15 there is a progressive decrease in the frequency of stone artefacts in the successive layers, and though this increases again in layers 14 and 13, it is only in layer 12 that the frequency again becomes substantial and, relatively, exceeds that of layer 19 (Table 2). Layers 18–13 share with layer 19 low frequencies of utilized and modified as well as retouched artefacts, although the frequency of utilized artefacts in layer 18 is the highest until layer 10, and layer 13 has a relative (percentage) frequency of retouched artefacts at least three times greater than those of any of the underlying layers (Table 2). That these are mostly scrapers is not unusual:

scrapers are the most common retouched artefacts in thirteen of the nineteen layers (Table 7).

J. Deacon (1978: 100) has characterized the lithic aspects of the 'Albany industry' at Nelson Bay Cave as being 'the almost exclusive use of quartzite as a raw material, the absence of Formal Tools other than scrapers and miscellaneous retouched pieces, the predominance of large scrapers over medium, the absence of backed tools . . .'. The 'Albany' layers at Nelson Bay Cave are approximately contemporary with BNK 1 layers 18-13, there being a hiatus in the Nelson Bay Cave sequence from about 8 000-6 000 B.P. There may also be a hiatus in the BNK 1 sequence, somewhere between layers 14 and 12, as indicated by the difference of about 2 000 years between the dates for these layers (Table 1). If there is, the stone artefacts suggest that it occurred between layers 14 and 13 rather than between layers 13 and 12. Although quartzite does become increasingly common in the BNK 1 deposits and is the most common raw material in layers 17-15, its use at this site cannot be said to have been 'almost exclusive' as it ranks second to quartz in almost half of the layers under consideration. From layer 14 upwards silcrete can be seen to play an increasingly important role (Fig. 7), and is generally the most common raw material for those artefacts considered to have been *used* (Table 3).

Retouched artefacts other than scrapers and miscellaneous retouched pieces are rare in layers 18-13, but they are present, except in layer 15 if it is preferred to consider notched flakes as utilized rather than retouched artefacts (cf. J. Deacon 1978, table 1), and backed pieces are absent only from layers 15-13. The paucity of scrapers in layers 18-13 makes it difficult to comment on aspects of size beyond pointing to the evidence of Figure 17, which shows that scrapers tend to become smaller from layer 18 to layer 16, then gradually increase in size to layer 13; but in all cases except layer 17 the mean length and width are indicative of medium to small scrapers, as defined by J. Deacon (1978: 92), rather than large ones.

Because of the hiatus in the Nelson Bay Cave sequence, it appears not to contain the sequence represented at BNK 1 by layers 12-10 and possibly 9, which seems transitional between the industries of the lower and upper layers. Layers 12-9 are characterized by the predominance of quartz as a raw material, except in layer 9, and by the increase in the frequency of silcrete, which becomes the dominant raw material in layer 9 (Fig. 7). In layer 12 there is a marked quantitative increase in the number of artefacts, relative to layers 18-13, and layer 11 has the highest AD of all the layers (Table 2). From layer 12, too, the frequency of utilized and modified artefacts increases, as does that of retouched artefacts, except in layer 11, which is more like layer 13 than the other layers with which it is grouped stratigraphically. Layers 12-10 contain 9 of the 12 classes of retouched artefacts and layer 9 all 12, compared with 2-5 classes in layers 19-13 (Table 7). It must be repeated, however, that the only new additions to the range are backed points (borers) from layer 12 up, backed scrapers from layer 10 up, and backed trapezoids from layer 9 up. There is a

marked phasic trend in scraper morphology in layers 12–9 (Fig. 17), but whether this trend really begins in layer 14 or below cannot be determined on account of the small sample sizes from layer 13 down.

From layer 8 up the declining trend in the relative frequency of quartz persists until layer 6, after which frequencies generally increase until the end of the sequence in layer 1, where it again becomes the predominant raw material. This gain is chiefly at the expense of silcrete which, however, still remains the dominant raw material in the utilized and retouched artefact categories.

Scraper morphology remains largely unchanged in these layers. Scrapers are mostly in the medium to small size ranges, with more in the medium range than in the small, and shape tends more to the equilateral than to the longer shape of the underlying layers (Fig. 17). The frequency of quartz scrapers increases in layers 6–3 and remains more or less constant in layers 2 and 1, but silcrete remains the most common raw material for this class (Fig. 14). The frequency of scrapers declines from layer 8 up, mostly relative to that of adzes, which show a continually increasing trend until layer 3, and even though frequencies decline in layers 2 and 1, adzes are more common than scrapers from layer 3 up. This suggests that the 'Sandy Bay industry' (Rudner & Rudner 1954), with its predominance of adzes, may represent a temporal phase of the 'Wilton' rather than a regional or environmental variant (cf. Sampson 1974: 414; Mazel & Parkington 1978). Comprehensive environmental data for the BNK area for the past 3 500 years are lacking, however, and an environmental interpretation is thus difficult to support.

It seems that while there may be a correlation between the frequency of adzes and the presence of a wooded environment, as suggested by Mazel and Parkington (1978: 382—cf. also Parkington 1980*a* and comments thereon), the overall picture is not yet clear. Whether the correlation between the relative frequencies of scrapers and adzes in different environments is more than merely statistical also remains to be established on the basis of independent palaeo-environmental data. At BNK 1 it is evident that the use of adzes is a feature that antedates the onset of the 'Wilton' but reaches its peak in the latter part of this 'industry'. Since the location of the site has not changed through time, if the frequency of adzes is correctly related to the availability of wood, then the increase through time may suggest a changing environment. On the other hand, it may simply reflect an increasing need for wooden artefacts in an environment in which suitable wood had always been available.

In the layers from 8 up the incidence of backed scrapers can also be seen to be episodic, with about 87 per cent of these artefacts in layers 6–4. Segments are most common in layers 9–5, numerically as well as relatively: the AD for layer 7 is 51, as against 16 for the numerically similar layer 1. The segments are most commonly made of silcrete, except in layer 1, where quartz segments are more common (Fig. 14). Segment lengths are largely constant in layers 9–6, after which they become shorter, while widths, which increase in layers 9–6, also decrease from layer 5 but increase again in layer 1. Segment shapes tend

towards a wider shape in layers 9–6, a longer shape in layers 5 and 4, but by layer 1 are again as wide as they were in layer 6 (Fig. 22).

Sampson (1974: 365–366), referring to the aptitude of the 'Howiesonspoort groups' in making a range of backed tools that included trapeze forms and obliquely backed pieces, comments that 'all knowledge of these techniques had completely disappeared by about 16 000 B.C. and cannot be detected in this area again until their reintroduction (in diminutive forms) at about 6 000 B.C. At this time the Oakhurst tool types are seen to dwindle via the early phase of the Wilton as microlithic types begin to increase. The origins of the coastal Wilton are not to be found in the Howiesonspoort sites'. Although the evidence of the BNK 1 lithic assemblage shows that backed artefacts are absent only in layers 15–13, say between about 10 000–8 000 B.P., it tends to support Sampson's statement about their reintroduction or, more correctly, increased used after about 6 000 B.P. (rather than B.C.).

It is difficult to know whether or where to separate layers 8–1 into different 'industrial' or small 'phase' groups since there is so much overlapping of the trends in the various components of the lithic assemblage. It seems, too, that such divisions should not be based on the data from one site alone but should be held in abeyance until a more comprehensive synthesis of information, on at least a regional basis, can be obtained. For the present, therefore, it seems advisable to keep layers 8–1 in the general category of the 'Wilton industrial complex' (cf. J. Deacon 1980: 91) although it is evident that there are differences within this group as great as those that distinguish it from the underlying 'Albany–Oakhurst–pre-Wilton' deposits. The data from BNK 1 suggest that further work is needed before satisfactory divisions within, as well as between, the 'Wilton Complex' and the 'Oakhurst Complex' can be made.

BONE ARTEFACTS

A total of 155 modified or utilized bone artefacts was recovered from the deposits and an inventory of these is given in Table 11. From this it will be seen that almost 91 per cent of the site total came from layers 9–1 and that seven of the nine classes are restricted to these layers.

TABLE 11
Bone: inventory of modified and utilized artefacts.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Class																				
Awls	14	1	3	5	19	7	1	2	2	1	—	—	—	—	—	1	1	—	2	59
Points	2	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Linkshafts	—	—	—	3	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
Spatulae	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	3
'Fish gorges'	—	—	—	—	—	—	—	—	—	—	—	—	2	4	2	—	—	—	—	8
Ornaments	5	1	2	—	—	2	1	—	—	—	—	—	1	—	—	—	—	—	—	12
Tubes	5	—	—	4	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11
Broken:																				
tips	2	—	—	1	4	3	—	—	—	—	—	—	—	—	—	—	—	—	—	10
other	5	—	—	2	6	2	—	—	—	—	—	—	—	—	—	—	—	—	—	15
Utilized	20	—	2	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	26
Layer total	55	2	7	15	39	14	5	2	2	1	—	—	3	4	2	1	1	—	2	155

Awls (Fig. 29)

These are the largest single class, accounting for 38,3 per cent of the site total, and have the widest distribution through the layers. Layers 3 and 5 each have an example of the slender artefacts termed 'needle awls' (Fig. 29A–B). Seven of the awls, from layers 2, and 4–6, are made of bird bone, the rest being of mammal bone.

Points

Artefacts in this class, considered to be projectile heads (e.g. Schweitzer 1979: 129–30), came from layers 1 and 5. The three artefacts are all broken and are not illustrated (cf. Schweitzer 1979, fig. 10). Parts of broken points are probably included among the unclassifiable broken artefacts (see below), so that undue importance should perhaps not be attached to their apparently restricted distribution.

Linkshafts (Fig. 30A–H).

These pointed artefacts are also considered to be parts of composite projectiles. In the BNK 1 sample they are represented by eight whole or almost whole pieces from layers 4 and 5. The artefact illustrated in Figure 30H is unusual in having a V-shaped notch at the lower end. This raises some doubt as to its correct identification as a linkshaft as it may be the nock end of a composite arrow. As far as is known, however, such parts made of bone have not been recorded from other archaeological deposits. E. M. Shaw (1980 pers. comm.) has pointed out that this piece, as well as one other (Fig. 30G), have split tips, and has suggested that these might have been slots to take the arrowhead. This would have been a type different from the points described above, and the slots would apparently not have been more than 1–2 mm wide and could thus only have accommodated a thin sliver of bone, stone or wood. None of the linkshafts is decorated, as was the case with some from Die Kelders (Schweitzer 1979, fig. 11).

Spatulae (Fig. 30I–K)

These were recovered only from layers 1 and 7. Those from layer 1 are made from mammal ribs while that from layer 7 is made from hippo ivory, probably a maxillary incisor or canine (R. G. Klein 1980 pers. comm.). The cancellous bone of the complete spatula is worn smooth for about half the length of the artefact and, opposed to this, the cortex bears a number of indentations, visible in Figure 30I. This wear might have resulted from the use of these tools, *inter alia*, for prising *Haliotis midae* from the rocks. This suggestion has been dismissed by various other workers on the grounds that the bone would be too brittle to withstand the strain of the upward lifting movement necessary for detaching the shellfish. Avery & Siegfried (1980: 33) have, however, also suggested a similar use, and this hypothesis could be tested by replication, using 'green' bone, since this is as likely to have been available



Fig. 29. Bone awls. A, D, K, P, R-S. Layer 5. B-C. Layer 3. E, L, Q. Layer 4. F. Layer 19. G-H, J, N-O. Layer 1. I, M. Layer 6. T. Layer 8.



Fig. 30. Bone artefacts. A-H. Linkshafts. I-K. Spatulae. A, C-D, F-H. Layer 5. B, E. Layer 4. I, K. Layer 1. J. Layer 7.

as dry bone. Similar wear and indentations are evident on some of the spatulae from Die Kelders.

'Fish gorges' (Fig. 31)

These artefacts, of which eight were found, in layers 13–15, are small, flat pieces of bone tapered to sharp points at both ends. What might be the fragment of a ninth was recovered from layer 18 but has been included with the unclassifiable broken artefacts since the fragment represents not more than a third of what would have been its full length if it were a 'fish gorge'. It is worth noting at this point, in view of the assumed function of these artefacts, that only four fish are recorded from layers 13–15 and none for layer 18. This leaves open the option of deciding whether these were or were not fishing aids, whether they were largely ineffectual, or whether the bulk of the fish caught with them were eaten away from the site.



Fig. 31. Bone 'fish gorges'. A, C–D. Layer 14. B. Layer 15. E–F. Layer 13.
Largest bone = 2,7 cm.

Ornaments

Bone artefacts considered to be ornaments were recovered from five of the layers. They are mostly broken, and most are illustrated in Figure 32G–K and M–Q. Those from layer 1 consist of half a small bead (Fig. 32I), part of a ring (Fig. 32K) and two fragments with drilled apertures (Fig. 32N–O), of which

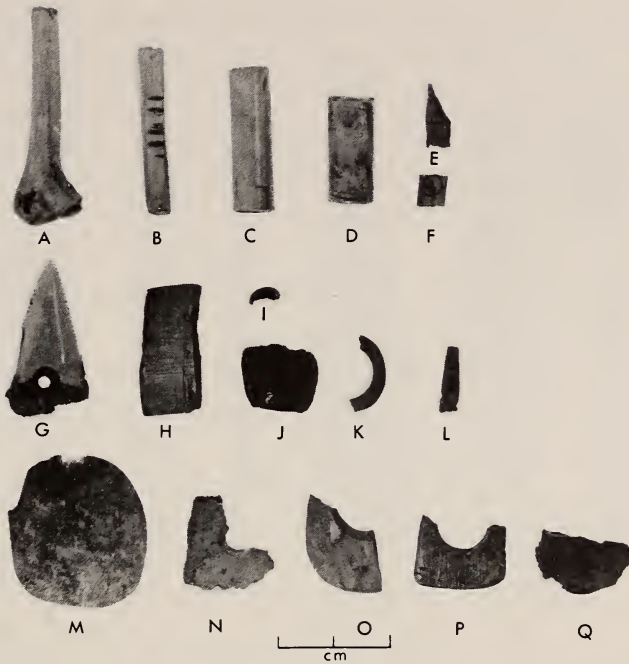


Fig. 32. Bone artefacts. A. Articular end of grooved and snapped bird bone. C-E. Bird bone tubes (D and E broken). G-Q. Ornaments. A, C. Layer 5. B, D, F. Layer 4. E, I, K-L, N-O. Layer 1. G. Layer 7. H, M. Layer 6. J. Layer 13. P. Layer 3. Q. Layer 2.

only the second appears to have reached any degree of completion, having a finely ground edge. The fifth piece from this layer, not illustrated, is doubtfully ascribed to this class: it is a small bone tube, 3 mm long with an outside diameter of 5 mm and a wall thickness of about 1 mm.

From layer 2 came a partly perforated fragment which has been broken into a roughly circular shape (Fig. 32Q), and layer 3 yielded a better-finished version of the layer 2 artefact, except that this is squared (Fig. 32P). This layer also yielded a small piece of bone, 8 × 4 mm, that has incised grooves on one side and five partial perforations on the other (not illustrated). Layer 6 yielded a broken fragment of limb bone that shows cut marks along its edges and has been pared down from its original dimensions to a wall thickness of 1–1.5 mm (Fig. 32H), and a roughly circular disc, finely ground down to 1 mm thickness (Fig. 32M). From layer 7 came the tooth of a Great White shark (*Carcharodon carcharias*) with an 'hour-glass' perforation drilled from both sides (Fig. 32G); and from layer 13 a bead similar to that from layer 1 but larger (Fig. 32J).

Tubes

Pieces of bird bone cut into tubes were found in layers 1, 4 and 5 and are illustrated in Figure 32A-F. Two of the pieces, from layers 1 and 5, are

articular ends that are probably discards after the tube had been detached from the shaft by ring-grooving and snapping (Fig. 32A). The pieces illustrated in Figure 32B and E, from layers 4 and 1, have linear decoration across the tube while the others are plain. These artefacts might have been ornaments, or they might have been links used in composite arrows. Their restriction to layer 5 and above is consistent with the distribution of points and linkshafts in the deposit.

Unclassifiable broken artefacts

Twenty-five broken pieces have been listed in Table 11 under the headings of tips and 'other', i.e. end or body parts. They are small pieces, usually not more than 10 mm long, of which not enough is present to identify securely the artefact type from which they came. The tips may be those of awls or points. Two, both from layer 5, are unusual in having the first millimetre or so thinner than the rest of the piece, and appear to have been used as drills. This feature cannot be observed on any of the awls or points.

The other broken pieces are probably mostly fragments of points and linkshafts although some of them that are more oval than round may be parts of awls. The fact that both types are restricted to the same set of layers 1, and 4-6, may be coincidental, but it may also indicate that points and foreshafts were in use before layer 5 was deposited.

Utilized pieces

These pieces, mostly from layer 1, are a miscellany that show marks of damage or utilization of a type that suggests their informal use. A range of these is illustrated in Figure 32L and Figure 33. Two horn-cores from layer 1, of which one is illustrated (Fig. 33D), have marks from chopping or cutting, as does the small polished piece shown in Figure 32L. Figure 33H-I illustrates two bovid scapulae, probably sheep (R. G. Klein 1980 pers. comm.), from layer 1 and Figure 33J a comparative specimen, from a young adult sheep, to show the extent of the wear on the archaeological specimens, of which the edges opposite the posterior border are considerably reduced and worn smooth, suggesting that they were used for some sort of scraping activity. The other pieces shown in Figure 33 show varying degrees of wear or grinding and in some cases (e.g. A and E) striations.

MARINE SHELL ARTEFACTS

Artefacts made of marine shell were recovered from layer 16 up and fall into two major categories, ornaments and edge-damaged pieces. The inventory of these is given in Table 12.

Ornaments

These have been divided into two classes, whole shells that are perforated but have no other modification, and a range of modified shell fragments with or without perforations, here informally termed 'pendants'.



Fig. 33. Utilized or damaged bone, all from layer 1, with a modern sheep scapula (J) to show extent of wear on H and I.

TABLE 12

Marine shell: inventory of ornaments and edge-damaged artefacts.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Perforated whole shells																	
<i>Glycimeris queketti</i>	126	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	127
<i>Nassa kraussiana</i>	40	—	—	5	1	—	—	1	1	—	—	—	—	2	—	—	50
<i>Tricolia kochi</i>	16	1	2	3	7	—	—	—	—	—	—	—	—	—	—	—	29
<i>Conus</i> sp(p).	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2
<i>Cypraea</i> sp(p).	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	6
<i>Bullia</i> spp.	1	—	—	1	12	1	—	3	3	—	—	—	—	—	—	—	21
<i>Donax serra</i>																	
whole	—	—	—	—	2	3	2	—	1	—	—	—	—	—	—	—	8
broken*	—	—	—	—	29	68	33	25	27	3	—	—	3	—	2	1	191
Other	2	1	1	3	2	1	1	3	—	—	—	—	—	—	—	—	14
Total	191	2	3	13	54	73	36	32	32	3	—	1	3	2	2	1	448
Pendants																	
perforated																	
plain	4	2	3	4	6	4	4	—	1	—	—	—	—	—	—	—	28
decorated	1	2	2	2	6	2	—	1	1	—	—	—	—	—	—	—	17
unperforated																	
plain	4	—	2	—	4	1	—	2	—	—	—	—	—	—	—	—	13
decorated	—	—	—	—	2	4	—	1	1	—	—	—	—	—	—	—	8
Total	9	4	7	6	18	11	4	4	3	—	—	—	—	—	—	—	66
Edge-damaged <i>Donax serra</i>																	
whole	4	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	5
fragments	97	—	—	3	1	1	3	—	6	4	3	6	—	—	—	—	124

* Frequencies estimated from the mass of broken fragments showing signs of perforation.

Perforated whole shells (Fig. 34) are the simplest form of shell ornament, requiring only the making of a hole to allow for stringing or attachment to the person in some other way. The most common of these are the valves of *Donax serra* (not illustrated) of which most in the BNK 1 sample are broken. With very few exceptions, the perforation was made by punching out a piece of the shell wall, almost invariably from the inside of the shell and regardless of whether it was a gastropod or bivalve. This may well account for the high number of broken *Donax serra* valves, since the holes punched in these shells are usually large, up to 20 mm diameter.

Five *Glycimeris queketti* shells have apertures made by grinding away the umbo (Fig. 34G–H) while the third shell illustrated (Fig. 34I) has a punched hole. Two *Conus* sp. shells (Fig. 34L–M) have V-shaped notches filed into the outer wall opposite the aperture of the shell. At Die Kelders, this method of making perforations was restricted to *Conus* shells (Schweitzer 1979: 144), and the presence of a similarly perforated shell in BNK 1 layer 12 attests to the continuity of the tradition over a period of at least 6 000 years.

A single, broken *Perna perna* valve from layer 8, not illustrated and listed in Table 12 under 'other', is the only instance of a shell ornament not a 'pendant' that has a drilled perforation. This was drilled near the umbo and from the inside only and has the inward-sloping sides characteristic of drilled apertures.

Four of the *Cypraea* shells are broken, with the section of wall opposite the aperture missing almost to the columella. It has not been possible to determine whether this damage is natural or not: similarly damaged shells are to be found



Fig. 34. Marine shell ornaments: perforated whole shells. A. Layer 8. B-C, E-I, L. Layer 1. D, J-K. Layer 4. M. Layer 12.

on the sea shore. It is possible, however, that these shells may have been ground down, as seems to have been the case with the *Nassa kraussiana* shells (cf. Fig. 34F). One of the *Cypraea* shells, from layer 1, is filled with some kind of ochre-stained deposit, possibly organic. This suggests that it might have been used as an ornament, since similarly stained ostrich egg-shell beads are often found.

Layers 9-1 yielded 97,3 per cent of the total of perforated whole shells, of which 42,6 per cent are in layer 1 alone. After the estimated total of *Donax serra* valves (42,6% of the category total), the most common species are *Glycimeris queketti* (28,3%) and *Nassa kraussiana* (11,2%).

'Pendants' made of worked shell fragments are entirely restricted to layers 9-1, and are most common in layers 5 and 6. In Table 12 they are divided into two classes, perforated and unperforated, each with two sub-classes, plain and decorated. Examples of all the types are illustrated in Figures 35 and 36. A more comprehensive analysis, based on attributes such as shape, size, number of perforations, and type of edge decoration was found not to be useful since the degree of individualism is so great that the analysis would ultimately have had almost as many divisions as there are artefacts, and it must suffice to say that the greatest variety occurs in layer 5.



Fig. 35. Marine shell ornaments: 'pendants' with plain edges. A, D-E, J-L. Layer 5. B, G-H. Layer 6. C, I. Layer 4. F. Layer 7. M, O. Layer 1. N. Layer 2. P. Layer 8.

All but three of the pendants are made of *Turbo sarmaticus*. They consist mostly of the nacreous inner shell, the periostracum having fallen away or been removed, and in every case the perforations have been drilled from the inner surface of the shell. The three not made of *Turbo sarmaticus* are two of *Haliotis midae* from layers 1 and 4 (Fig. 36J-K), and one from layer 6 made from the apex of a *Patella* species (Fig. 36V).

Whether or not the unperforated pendants are merely unfinished pieces is hard to determine. A particular type with denticulate edges (Fig. 36N-Q), of which there were 2 in layer 4, 4 in layer 5 and 1 in layer 9, has no perforations, nor are there any like it in the sample that do. This suggests that they were possibly not intended to be perforated. Kolb (1738: 197) observed that the

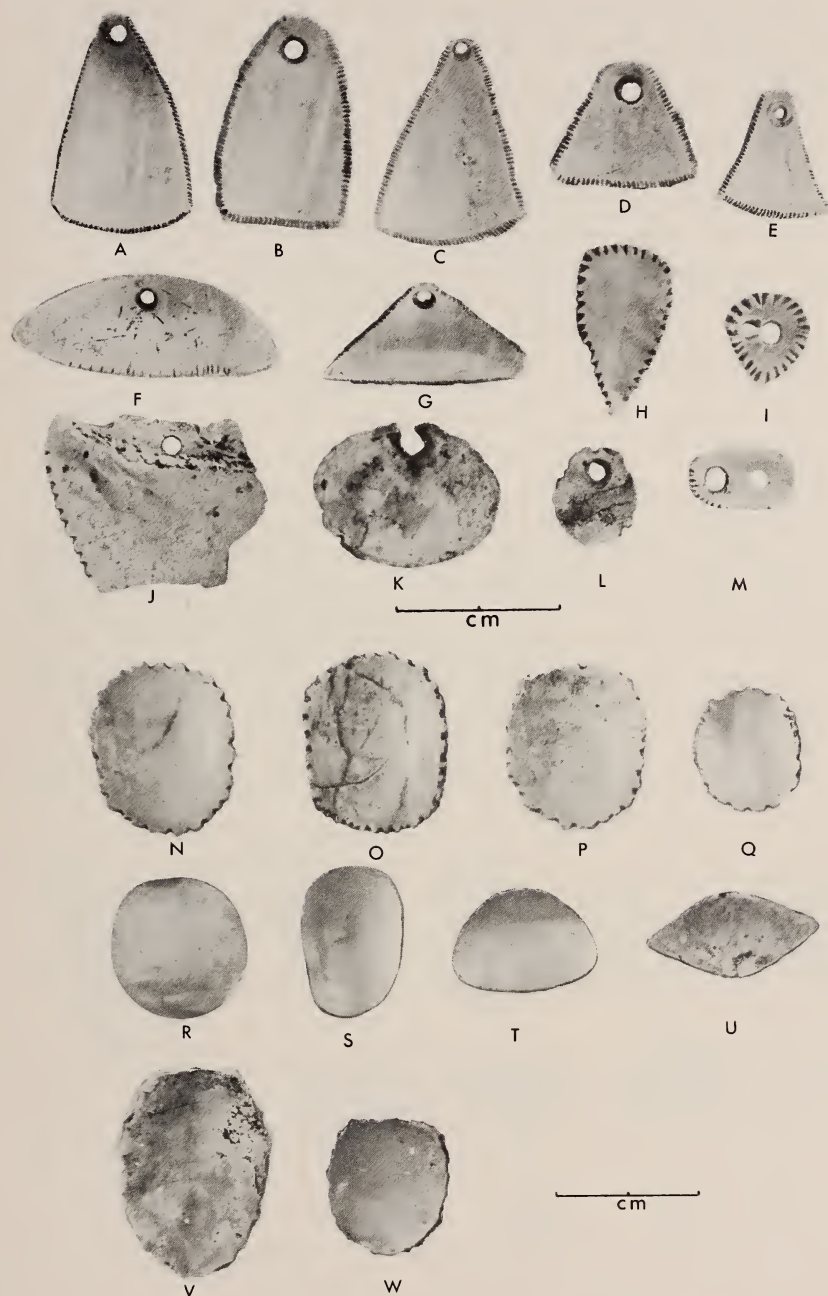


Fig. 36. Marine shell ornaments: 'pendants' with decorated and plain edges; perforated and unperforated. A, C-D, F-G, N, P, S, W. Layer 5. B, J. Layer 4. E, O, Q, V. Layer 6. H, K. Layer 2. I, R. Layer 1. L. Layer 9. M, T-U. Layer 3.

Hottentots were very fond of ornaments for the head, which they fastened to their hair. These denticulate discs could perhaps have been tucked into the hair but would not have been very secure. With reference to 'pendants' in general, Kolb (1738: 198) mentions that the Hottentots pierced their ears with what, in archaeological parlance, would be termed bird-bone awls and then passed brass wire rings through the perforations. 'To these Rings the Wealthy and Eminent hang Bits of Mother of Pearl, to which they have the Art of giving a very curious Shape and Polishing.' It seems unlikely, though not impossible since we know so little of the social systems of the Khoi(san) in the early historic period, that such ornaments would have been restricted to those of high status, and their presence in the BNK 1 deposits as early as layer 9 certainly antedates the arrival of the pastoralist Khoi in the southern Cape by several thousand years.

Although the evidence of the BNK 1 deposits indicates the manufacture of marine shell ornaments for about the last 10 000 years, it is not until layer 9, about 6 000 years ago, that they become common and increase in sophistication. The possibility that the more fragile pendants might not have survived cannot be discounted, but the fact that these first appear at a time when there is evidence of change in other artefact traditions as well as a major increase in the frequency of marine shell representing food debris cannot simply be dismissed as coincidental. The low frequencies of shell ornaments in the layers below layer 9 are, however, also consistent with an interpretation based on a lower intensity of occupation prior to about 6 000 years ago, while the presence of ornaments from layer 16 up testifies to the exploitation of marine resources from about 10 000 years ago.

Edge-damaged Donax serra valves, mostly broken, were recovered from all but three of the layers from layer 12 up. In view of the generally low frequencies in the individual layers the absence of these artefacts from layers 2, 3, and 8 is probably fortuitous. On the other hand, the frequency of these artefacts in layer 1 (78% of the site total) is higher than can be explained by this layer having the greatest excavated volume. In this respect layer 1 resembles the Holocene deposits at Die Kelders, which fall within the time range of this layer and also contained a high frequency of these artefacts (Schweitzer 1979, table 10).

Despite certain initial reservations as to the validity of classifying these pieces as artefacts, let alone 'scrapers', evidence from Die Kelders suggests that they are artefacts, even if their function can only be presumed. In the tidal wash below Die Kelders Cave, valves of *Tivela compressa* are commonly found, almost invariably with damage to the periostracum of the ventral margin. This damage takes the form of chipping of the periostracum, almost as if small flakes had been removed in a regular and deliberate manner from the margin. This edge damage is, however, less pronounced than, and different from that found on the *Donax serra* fragments from the deposits. It is noteworthy that no *Donax serra* was recovered from the deposits with edge damage similar to that on the *Tivela compressa* valves from the beach, and that *Tivela compressa*, a

bivalve almost as big as *Donax serra*, was not found in the deposit. It is, therefore, concluded that the edge damage on the *Donax serra* valves and fragments recovered from the archaeological deposits is not natural and that such damaged pieces are thus correctly called artefacts.

That *Donax serra* 'scrapers' appear in the BNK 1 deposits only from layer 12 up is somewhat problematic. If these artefacts were indeed used as scrapers it is difficult to understand why this innovation should have occurred at a time when there is a marked increase in the frequency of stone scrapers (Table 7). It is certainly not explicable in terms of a shortage of suitable stone, and can only be seen as a technological innovation for which there seems, at present at least, no reasonable explanation. In layers 4-1 the frequency of stone scrapers decreases but there is not, except in layer 1, any increase in the frequency of the shell artefacts.

OSTRICH EGG-SHELL ARTEFACTS

Ostrich egg-shell, in the form of beads, 'pendants' and fragments, plain and decorated, was recovered from every layer of the deposits. Table 13 provides an inventory of the various classes, and it should be noted that, whereas frequencies for all other classes are numerical, those for plain fragments are the mass, in grammes.

Beads

Beads, whole and broken as well as partly made, are the most common of the worked material. Frequencies in the lower layers are low, with ADs of less than 100 for layers 19-10. From layer 9 frequencies increase until layer 6, after

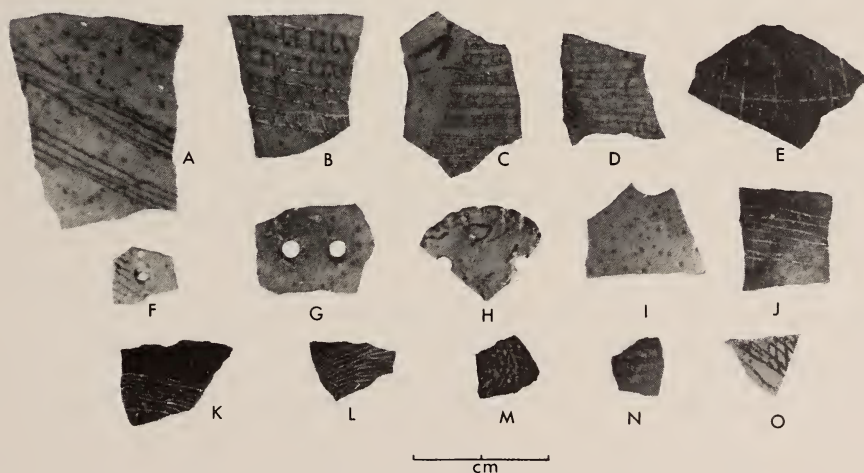


Fig. 37. Fragments of decorated or worked ostrich egg-shell. A, G, K-M. Layer 5. B-C. Layer 9. D, F, N-O. Layer 4. E. Layer 16. H. Layer 1. I-J. Layer 6.

TABLE 13
Ostrich egg-shell: inventory of classes.

Layer	whole	incomplete	Beads total	% site total	AD/m ³	Decorated fragments	'Flask' openings	Ground fragments	Pendants	Plain fragments	
										mass (g)	% site total
1.....	824	492	1 316	17.3	506	9	—	6	1	621	9.5
2.....	107	101	208	2.7	365	6	1	1	—	221	3.4
3.....	47	72	119	1.6	476	1	4	1	—	157	2.4
4.....	313	407	720	9.4	791	26	3	17	?1	546	8.3
5.....	505	468	973	12.8	785	40	3	2	2	641	9.8
6.....	554	852	1 406	18.5	1 674	25	2	4	—	360	5.5
7.....	418	919	1 337	17.5	1 651	19	—	—	—	509	7.8
8.....	254	652	906	11.9	1 562	11	2	—	—	441	6.7
9.....	240	228	468	6.1	459	27	1	—	—	613	9.4
10.....	18	21	39	0.5	70	—	—	—	—	98	1.5
11.....	6	5	11	0.1	39	—	—	—	—	39	0.6
12.....	12	2	14	0.2	25	—	—	—	—	131	2.0
13.....	—	1	1	0.01	2	—	—	—	—	35	0.5
14.....	7	5	12	0.2	16	—	—	—	—	105	1.6
15.....	3	1	4	0.05	7	—	—	—	—	186	2.8
16.....	4	2	6	0.08	10	2	—	—	—	416	6.4
17.....	—	2	2	0.03	3	—	—	—	—	336	5.1
18.....	10	15	25	0.3	38	1	—	—	—	327	5.0
19.....	23	26	49	0.6	50	—	1	—	—	753	11.5
Total.....	3 345	4 271	7 616			167	17	31	4	6 535	

Note. 'Incomplete' includes broken as well as partly made beads.

which they decline again, more noticeably in terms of ADs than of actual numbers.

No attempt was made to determine whether there was any change in bead size through time. Visual observation suggests that most beads fall within a size range of 4–8 mm diameter, and in view of the low frequencies in the lower layers any changes in size might be more statistical than real. Schweitzer (1979: 150) has pointed out that about 2 000 beads are required for a multi-stranded necklace and 8 000 for an apron, and the BNK 1 site total of 3 345 completed beads is thus not impressive. It is perhaps interesting only for the evidence it provides of the persistence of the tradition and manufacturing technique over a period of some 12 500 years.

Decorated shell fragments

Apart from three pieces in layers 16 and 18, decorated shell fragments are restricted to the upper layers, from layer 9 up. At least twenty-five different types of decoration could be identified, and some of these are illustrated in Figure 37.

Most of the decoration consists of linear incisions, but a few pieces have decoration in which the surface of the shell has been pecked or abraded. Quantification of the different types of decoration is not considered particularly useful, since the number of fragments is not directly proportional to the number of whole shells, nor is it likely that each type of decoration represents an individual shell. A whole shell in the Museum's collections (AA5863), taken from a 'Bushman' grave at Boegoeberg, in the Gordonia district of the northern Cape, is richly decorated over most of its surface, and at least ten different types of decoration can be recognized (cf. J. Rudner 1971, fig. 1).

It is perhaps worth noting that layers 7–5 have the greatest variety of types of decoration.

'Flask' openings

Fragments of shell with parts of ground circular apertures (Fig. 37I) are, apart from one in layer 19, restricted to layer 9 and above. As with the decorated shell fragments from layers 16 and 18, the recovery of a 'flask' opening from layer 19 was cause for a certain amount of concern, if only because worked artefacts are so rare in the lower layers.

Ground fragments

Pieces with ground edges and in some cases smoothing of the outer surface of the shell were found in layers 5–1. These generally small fragments may be parts of 'pendants' or discs, but complete examples of the particular type(s) represented by these fragments were not found.

'Pendants'

Fragments of four artefacts, informally termed 'pendants', were found in layers 1 and 4–5. The most complete of these, from layer 1, is illustrated in

Figure 37H, as well as a fragment with two holes drilled through it (Fig. 37G) that bears some resemblance to the perforated marine shell 'buttons' (Fig. 35G-L).

Plain fragments

Unmodified fragments of shell are not distributed throughout the layers in proportion to the frequencies of beads. Layers 19-16, 9-7, and 5-3 all have mass ADs of more than 500 g, while layer 6, which has the highest frequency of beads, actual as well as AD, has one of the lowest mass ADs of the upper layers. Layer 19, on the other hand, has the highest frequency of beads in the lower layers as well as the highest mass of plain fragments of all the layers.

To summarize, about 98 per cent of the site total of beads are from the upper layers, as are 99 per cent of the decorated fragments, all but one of the 'flask' openings, all the ground fragments and the 'pendants', and almost 63 per cent of the total mass of plain fragments. Whether the ground fragments and 'pendants' can be regarded as innovations during the last 4 000 years or so is not clear from the sparse evidence provided by the BNK 1 data, but the presence of the other classes, even if sporadically, in the lower layers suggests a continuity in the traditions of artefact manufacture in ostrich egg-shell over a period of at least 10 000 years. The presence of a 'flask' opening in layer 19 and decorated fragments in layers 18 and 16 may be seen as problematic, since these artefact types do not otherwise occur in the deposits before layer 9; but it seems not improbable that people who had the technical ability to make ostrich egg-shell beads would also have been capable of grinding smooth the openings of perforated shells and of the simple, linear incisions required to decorate these shell containers.

The probability cannot be discounted that some of the plain fragments may represent food waste rather than artefactual material in the strict sense, but it seems equally likely that even the shell used for the artefacts had its contents extracted for food before the shell was used. This is probably true of most of the classes of organic material and merely shows that it was not necessarily only the edible parts of animals, plants and birds that had economic value.

POTTERY

A total of 426 potsherds was recovered from layer 1. Because of uncertainty regarding the degree of disturbance of the upper sub-units of this layer, because the front four squares were excavated in a greater number of sub-units than the squares in the main trench, and because the number of sherds is so small, no attempt has been made in this analysis to retain the sub-unit divisions employed in the excavation, which might otherwise have provided information regarding changes in style and technique. Twenty-six sherds were recovered from the lowest sub-unit of layer 1 but are presumed to relate to the overlying sub-unit in view of the date of $3\,220 \pm 45$ years B.P. obtained for the lowest sub-unit (Table 1).

TABLE 14
Pottery: inventory of sherds.

	no.	% of working total
Excavated total	426	
Joins	19	
Working total	407	
Rims:		
vessel	20	4,9
spout	1 + ?1	0,5
Decorated		
rim	7	1,7
neck/body	2	0,5
Burnished	134	32,9
Burnished plus ochre	22	5,4
Unburnished plus ochre	45	11,0
Split fragments	57	14,0
Working total for thickness (working total less split fragments)	350	86,0
Thickness		
range		2-10 mm
mean		5,4 mm
std. deviation		± 1,3 mm

Table 14 contains an analysis of the relevant sherd data. From this it will be seen that it was possible to join only 19 pairs of sherds, giving a working total of 407 sherds. Of these, 22 are rim sherds, of which possibly 3 are spout rim sherds (Fig. 38P-R). The rest are neck or body sherds and include part of a decorated boss (Fig. 38T). A small fragment of a base was also found.

Burnish was evident on 156 sherds (38,3% of the working total), of which 22 (5,4% of the working total) also showed evidence of red ochre staining. Ochre was found on a total of 67 sherds (16,4% of the working total). Burnish appears to have been more common on the sherds of the lower sub-units, but such an observation must be treated with caution, not only because of the possible disturbance of the deposit but also because the number of sherds is not a direct indication of the number of vessels represented; and it must also be borne in mind that the evidence of burnish can be destroyed by use during the lifetime of the vessel as well as by post-depositional factors. Carbonized matter, presumably organic (cf. Schweitzer 1979: 165-7), was noted adhering to some of the sherds.

A morphological analysis of rim sherds was not considered to serve any useful purpose because of the high degree of fragmentation of the sherds and because study of complete vessels has shown that there is often quite considerable variation in the shape of the rim of one vessel, to the extent that sherds that could be classified as rounded or squared could form part of the rim of the same vessel. A study of the rim sherds indicates, however, that at least nine different vessels are represented, of which two, possibly three, were spouted and one had a boss or bosses.

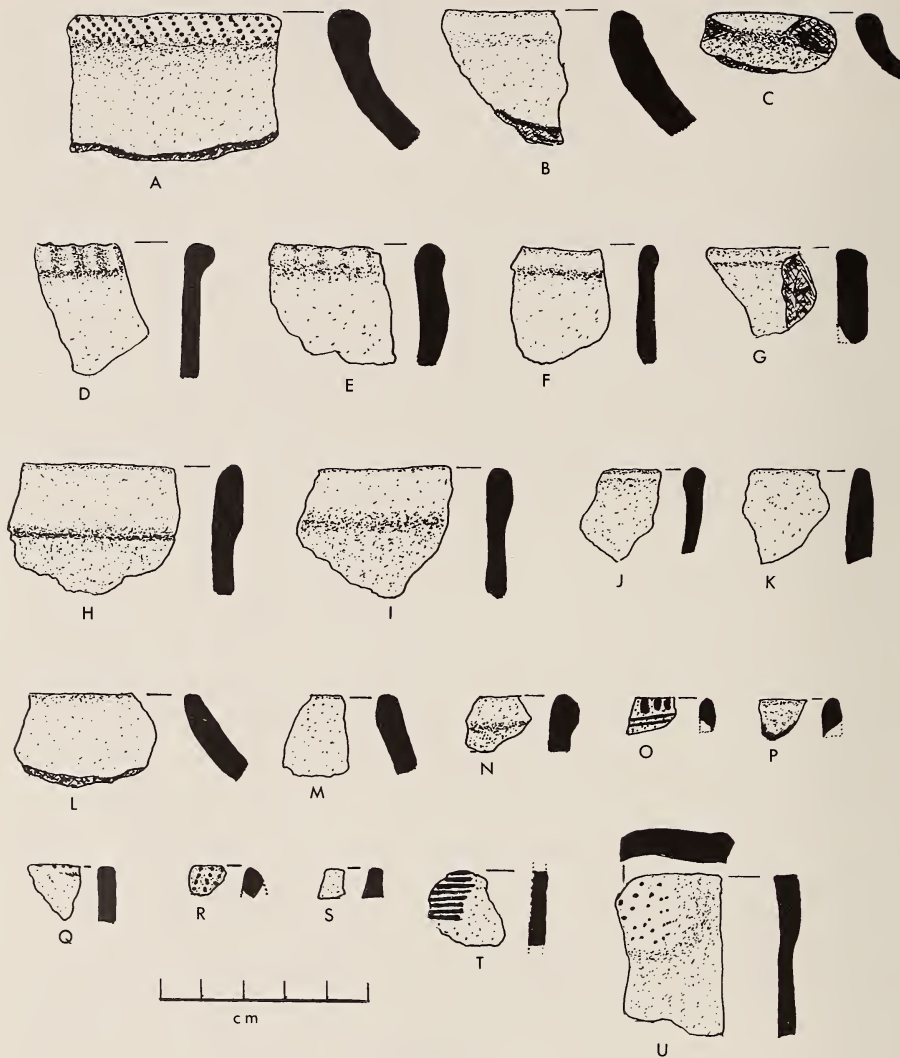


Fig. 38. Potsherds, all from layer 1.

Replication studies (Wilson & Halkett, 1981) have shown that the decoration on the rims of the sherds illustrated in Figure 38A, R and (minimally) Q was probably produced by impressing the ventral margin of a *Donax serra* valve across the rim, and the same 'tool' may have been used to decorate the boss (Fig. 38U). The decoration on the rims illustrated in Figure 38D–E might have been produced either by pinching the rim between closed fingers, with the thumb on the inside, or by pressing a finger, stick or other rounded implement into the clay. The third type of decoration (Fig. 38O, T) is a series of impressed bands, for which the 'die' may have been a piece of reed or grass.

The sherds range in thickness from 2,0 to 10,0 mm, with a mean thickness and standard deviation of $5,4 \pm 1,3$ mm.

The bulk of the sherds contain a medium to low density of quartz grit, mostly in the 0,5–1,0 mm size range but also including larger pieces. Some of the sherds include shale or siltstone fragments, but these occur in low frequency in a matrix of quartz grit and the sherds cannot therefore be classed as 'shale-tempered', as were some from De Hangen (Wilson 1974: 57; table 1) and Die Kelders (Schweitzer 1979: 158–160). Crushed quartz chips were also observed in sherds from the upper sub-units but these are included in a matrix of fairly large rolled quartz grains up to 3,5 mm diameter. This suggests that the chips might have resulted from the grinding or pounding of dry clay, or the fracturing of larger quartz grains during firing. A change from the use of quartz grit to crushed quartz chips, observed in sherds from the upper sub-units of the DGL member at Boomplaas, was regarded as a technical innovation (Wilson 1976: 16; H. J. Deacon *et al.* 1978: 54). Shepard (1954: 27) has pointed out that rounded grains weaken a clay body more than sharp, irregular ones.

Fifteen sherds contain carbonized organic material mixed into the clay, but whether this was deliberately introduced is doubtful, since the sherds also contain a 'normal' amount of quartz grit. The number of sherds with organic inclusions may be higher than fifteen, since these inclusions are difficult to detect in a dark-coloured clay body.

Eight sherds contain a medium density of fine shell grit about 0,5 mm or less in maximum dimension. This grit is rolled, and the fact that it is mixed with an equally fine quartz grit suggests that it is a natural admixture, either in the clay or in the grit, if this was added by the potter. In either case, a source not far from the sea is indicated.

METAL ARTEFACTS

A small bead of cuprous metal, copper or brass, was recovered from the second sub-unit from the top of layer 1, in one of the front four squares, O 31. Charcoal from the same sub-unit in this square yielded the youngest date for the site, 255 ± 50 years B.P. (Table 1).

The bead is 3,5 mm long and has an external diameter of 9,5 mm, with a wall thickness of 1,5 mm. It was evidently made by rolling a strip of metal into a circular form. The bead has not been cleaned to remove encrustation but it appears that the two ends of the strip are merely joined, not soldered or welded.

SUMMARY

Stone artefacts make up the bulk of the artefactual content of the deposit. Quartz is generally the most common raw material, though silcrete shows an increasing trend in layers 16–5 and is generally the most common raw material for artefacts in the utilized and retouched categories. Quartzite is more common in layers 19–13 than in the overlying layers, and limestone, although in low

frequencies in most layers, is more common in layers 9–1 than in the underlying layers. Chalcedony and shale are both minimally represented in the sample.

As is usual, unmodified ('waste') pieces comprise the major part of the stone artefact sample, with frequencies ranging from 93,9 to 99,7 per cent of individual layer totals. Utilized or modified pieces are a constant if minor component, with individual layer frequencies ranging from 0,1 to 1,4 per cent of the layer total. Retouched artefacts are few in the lower layers, with individual layer frequencies ranging from 0,1 to 1,1 per cent of layer totals in layers 19–11. Frequencies in the upper layers increase, however, to the range of 1,4 to 5,0 per cent of individual layer totals.

Utilized flakes, 90,5 per cent of them silcrete, are the most common class in the utilized and modified artefact category (48,5 % of the category total), and are more common in layers 12–4 than in the other layers. Scaled pieces rank second in frequency (41,7 % of the category total) and are more or less evenly divided between quartz and silcrete. Apart from layers 18 and 12, they are more common in layers 9–4 than in the other layers.

Scrapers are the most common artefacts in the retouched artefact category, accounting for 52,1 per cent of the category total. They are most common in layers 12–4 but in layers 3–1 their predominance is superseded by that of adzes, which account for only 12,2 per cent of the category total and assume relatively significant frequencies only from layer 5. A limited morphological analysis shows a difference between the scrapers in layers 13–10 and 8–1, those of layer 9 being intermediate between the two groups.

Backed scrapers (7,4 % of the retouched artefact category total) are most common in layers 7–4 and segments (11,5 % of the category total) are most common in layers 10–4 and again in layer 1. In layer 1 the segments are mostly quartz, while in the other layers they are mostly silcrete.

Layers 19–13 yielded only 2,6 per cent of the total of retouched artefacts, 14,4 per cent of the utilized-modified artefacts and 27,9 per cent of the unmodified artefacts, of which more than a third came from layer 19 alone.

The stone artefact assemblage suggests the following grouping: layers 19–18, 17–13, 12–5 and 4–1, although there are various aspects, particularly in the retouched artefact category, that either cut across these groups or form subdivisions within them.

Bone artefacts are a relatively minor component of the artefact assemblage. They are numerically most common in layer 1 but the ADs show higher frequencies relative to excavated volume for layers 5 and 3. Frequencies, actual or AD, are moderately high only in these three layers, and suggest that bone was not an important component of the artefact assemblage in layers 19–6.

Marine shell artefacts consist of ornaments and edge-damaged *Donax serra* 'scrapers'. Whole shells with perforations are relatively common only in layers 9–5 and 1 but are present from layer 16 while the more elaborately worked 'pendants', mostly made from *Turbo sarmaticus*, were not found below layer 9 and are most common in layers 6 and 5. *Donax serra* 'scrapers' are present in

most layers from layer 12 up but are common only in layer 1, in which stone scraper frequencies are low compared to those for layers 9–4.

Ostrich egg-shell artefacts, mostly beads, are present in all the layers but with individual layer frequencies of less than 1 per cent of the site total in layers 19–10. Beads are relatively most common, on the basis of ADs, in layers 8–6, while fragments of decorated shell are numerically most common in layers 9–4, being found only in layers 16 and 18 of the layers below layer 9. Apart from one in layer 19, 'flask' openings were found only from layer 9 up, and ground shell fragments, possibly intended or used as ornaments, only from layer 6 up. 'Pendants' were found only in layers 5–4 and 1. The mass of unworked fragments varies from layer to layer, but frequencies are generally higher in the upper layers, 9 and above, although layer 19 has the highest frequency of all the layers.

Pottery fragments were recovered from layer 1 only, and the small number of highly fragmented sherds provides little information of value.

Metal artefacts are represented by one small bead of copper or brass from near the top of layer 1. This artefact, like the potsherds, is valuable chiefly for its presence in the deposits rather than for any information it provides concerning the ecology of the cave occupants.

HUMAN, ANIMAL, AND PLANT REMAINS

HUMAN REMAINS

As mentioned previously, during the excavation of the test pit in 1973, a human burial was encountered at a depth of approximately 0.7 m from the surface. These remains have been studied by H. de Villiers and the full analysis is included in the report on the human burials from BNK, most of which came from BNK 3 (De Villiers & Wilson 1982).

For the purposes of the present report it must suffice to quote De Villiers's conclusions that the remains are those of a child between the ages of 8–9 years and that the small size and pentagonoid form of the cranial vault are indicative of a Khoisan child probably assignable to the San (Bushman) group.

The skeleton has been added to the Museum's physical anthropology collection (SAM-AP6053). It was found lying on its left side in the usual contracted (foetal) position, with the skull facing approximately due north. Ornaments or grave goods were not found in association. Because of the fragile condition of the skull, it was treated *in situ* with a soluble adhesive.

It was not possible to establish from which layer the burial, found in what is now layer 6, was made and correlation with the artefactual content of the deposits will be possible only if a radiocarbon date is obtained. By analogy with a child burial from BNK 3, however, it may be suggested that the burial was made from between layers 2 and 4 rather than from layer 1.

Fragmentary human remains were also recovered from layers 1, 5–6, 10, and 14 (Table 15). As indicated in Klein's lists of body parts (Table 8 of Appendix 1), these are isolated teeth and/or postcranial material, mostly the smaller limb bones. Because of their lack of association with more complete burials these remains do little more than indicate the likelihood of disturbance of the deposits, probably during the site's prehistoric past as well as more recently.

MAMMALS

The remains of some 600 individual mammals recovered from the deposits were analysed and identified by R. G. Klein and these are listed in Table 15. Klein (1981a) has reported on the mammalian fauna from the 1974 excavation, which in general differs only quantitatively from that of the combined 1974 and 1976 samples.

Due to comminution of the bone or absence of diagnostic parts, identification in some cases was possible only at genus or even family level. In this connection it should be noted that in Table 15 the numbers for genera or families *include* the individuals listed separately under species. Thus, for example, the frequencies for *Raphicerus melanotis* are included in those for *Raphicerus* spp. as well as in those for 'Bovidae general—small'.

From Klein's tables of skeletal parts (Appendix 1) it may be observed that in general it is only the smaller animals that are represented by a more or less complete range of bones and teeth. Four species, *Atilax paludinosus*, *Equus* cf. *capensis*, *Phacochoerus aethiopicus*, and *Hippopotamus amphibius*, are represented only by elements of the skull, and two, *Ictonyx striatus* and *Panthera pardus*, only by post-cranial bones. In the case of the large bovids, individuals in layers 19–10 are represented only by cranial and limb parts, while in layers 9–1 other parts are also present. This is also true for *Oreotragus oreotragus* and small medium bovids, but in the case of *Raphicerus* spp. and large medium bovids all skeletal parts tend to be represented where these animals occur. This tends to dispel any suggestion of differential preservation in the lower and upper layers.

Although allowance must be made for agencies other than human being responsible for the accumulation of some of the bone, also that some of it might have been brought into the cave solely for artefactual purposes, it seems reasonable to assume that the bulk of the bone represents human food refuse. In the analysis and discussion that follow no attempt has been made to exclude those individuals whose remains might not have contributed to the diet of the prehistoric human inhabitants of the cave, with the exception of *Homo sapiens*, microfauna and lizard, the last-named being too few to be of any consequence (Table 21).

Excluding *Homo sapiens*, and allowing that the totals for genera and families include the species or genera listed separately, there are thirty-six taxa, mainly identified to species level, represented. No layer contains all the taxa,

and frequencies of these range from 9 to 21 in layers 19–10 and 7 to 26 in layers 9–1. Five species are restricted to layers 19–9: *Atilax paludinosus*, *Equus* cf. *quagga*, *E.* cf. *capensis*, *Phacochoerus aethiopicus*, and *Damaliscus dorcas*, while six were found only in layers 9–1: *Ictonyx striatus*, *Aonyx capensis*, *Felis* cf. *caracal*, *Raphicerus campestris*, and *Ovis aries*.

Almost two-thirds (64,4%) of the individuals are in layers 9–1, but this increase over the lower layers may in part be attributable to the different excavated volumes, the upper layers having a total excavated volume 18,6 per cent greater than the lower. However, no proportionate reduction of the frequencies in the upper layers has been made to compensate for this, on the assumption that the lower layers are likely to be more compressed than the upper. The AD totals for layers 19–10 and 9–1 are 368 and 413 respectively, indicating that the relative increase in the upper layers is only of the order of 12 per cent rather than 50 per cent. The increase in actual frequencies is, however, 81 per cent.

Frequencies in the individual taxa are generally too low to allow a meaningful layer-by-layer analysis. In consequence, comparisons are mostly restricted to the two groups of layers, and the frequencies have been combined further by grouping the taxa into approximate size classes. Since the size and mass of an animal are also relative to its age and sex, it has been difficult to form valid size groups on the basis of the limited data available from the remains. Table 16 summarizes such data as are available from Klein's tables (Appendix 1), in which juveniles and adults are indicated, where this could be determined, on the basis of unfused or fused epiphyses. The table includes some 90 per cent of the individuals listed in Table 15 but, as the third column in Table 16 indicates, about 40 per cent of the total are listed as 'indeterminate'. This means that the age group divisions in fact cover only about two-thirds of the total sample. Klein (1981*b*) has arrived at differing frequencies in the age groups of selected bovids, based on a study of dental wear.

The problem of whether the presence of limited body parts is merely a chance factor partly dependent on preservation, or whether, and to what extent, it represents the realities of prehistoric butchering and dietary practices tends to make it almost impossible to form meaningful size groups, and it would give a specious value to more precise attempts to interpret the dietary habits of the site's prehistoric inhabitants by using calculations based on the flesh mass when these are based on such scanty data.

Given these problems, the data contained in Table 17 and Figure 39 have limited value, and at best serve only to give a general idea of the distribution of size classes represented in the faunal sample and to provide a means for comparing changes in their relative frequencies. The six size classes used in Table 17 and Figure 39 are based mainly on data derived from Dorst & Dandelot (1972) and do not take into account the juvenile and adult frequencies indicated in Table 16. Identified juveniles account for only 20,5 per cent of the sample total and almost half of these are *Bathyergus suillus*, which falls into

TABLE 15
Mammals: inventory of minimum numbers of individuals.

Layer:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
<i>Papio ursinus</i>	1	—	—	1	1	1	1	—	1	—	1	—	—	1	—	—	—	—	—
<i>Homo sapiens</i>	1	—	—	—	1	1	—	—	—	1	—	—	—	1	—	—	—	—	—
<i>Canis cf. mesomelas</i>	1	—	1	1	1	1	—	—	—	?1	—	—	—	1	—	?1	—	—	—
<i>Ictonyx striatus</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Mellivora capensis</i>	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
<i>Aonyx capensis</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Herpestes ichneumon</i>	1	—	—	1	1	—	—	1 cf.	—	—	—	—	—	1	—	—	—	—	—
<i>Herpestes pulverulentus</i>	1	—	?1	1	2	1	1	?1	—	—	—	—	1	1	—	—	—	—	—
<i>Atilax paludinosus</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
<i>Hyaena brunnea</i>	1 cf.	—	—	—	1 cf.	—	—	—	—	—	—	—	1 cf.	—	—	—	—	1 cf.	—
<i>Felis libyca</i>	1	1	1 cf.	1	1	1	—	—	—	—	—	—	1	—	—	—	1	—	1 cf.
<i>Felis cf. caracal</i>	1	—	—	1	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—
<i>Panthera pardus</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Arctocephalus pusillus</i>	2	—	—	1	1	2	1	—	1	1	1	1	1	1	—	1	1	—	—
<i>Loxodonta africana</i>	—	—	—	1	1	1	—	—	—	—	—	—	—	1	1	1	—	—	—
<i>Procavia capensis</i>	2	—	—	1	1	1	1	1	1	—	1	1	1	—	1	1	1	1	2
<i>Diceros bicornis</i>	—	—	—	—	—	1	—	—	1	—	1	—	—	1 cf.	—	—	—	—	—
<i>Rhinocerotidae</i> gen. et sp.	1	—	—	—	1	1	—	1	1	—	1	?1	—	1	1	1	1	—	1
<i>Equus cf. quagga</i>	—	—	—	—	—	—	—	—	1	—	1	1	1	1	2	1	2	—	2
<i>Equus cf. capensis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
<i>Potamochoerus porcus</i>	1	2	2	2	2	1	1	—	1	1	—	—	1	—	1	?1	—	—	—

TABLE 15
Mammals: inventory of minimum numbers of individuals.

Layer:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
<i>Papio ursinus</i>	1	—	—	1	1	1	1	—	1	—	1	—	—	1	—	—	—	—	—
<i>Homo sapiens</i>	1	—	—	—	1	1	—	—	—	1	—	—	—	1	—	—	—	—	—
<i>Canis cf. mesomelas</i>	1	—	1	1	1	1	—	—	—	?1	—	—	—	1	—	?1	—	—	—
<i>Ictonyx striatus</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Mellivora capensis</i>	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
<i>Aonyx capensis</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Herpestes ichneumon</i>	1	—	—	1	1	—	—	1 cf.	—	—	—	—	—	1	—	—	—	—	—
<i>Herpestes pulverulentus</i>	1	—	?1	1	2	1	1	?1	—	—	—	—	—	1	1	—	—	—	—
<i>Atilax paludinosus</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
<i>Hyaena brunnea</i>	1 cf.	—	—	—	1 cf.	—	—	—	—	—	—	—	—	1	—	—	—	—	—
<i>Felis libyca</i>	1	1	1 cf.	1	1	1	—	—	—	—	—	—	1	—	—	—	1	—	1 cf.
<i>Felis cf. caracal</i>	1	—	—	1	1	1	—	—	1	—	—	—	—	—	—	—	—	—	1 cf.
<i>Panthera pardus</i>	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Arctocephalus pusillus</i>	2	—	—	1	1	2	1	—	1	1	1	1	1	1	—	1	—	—	—
<i>Loxodonta africana</i>	—	—	—	1	1	—	—	—	—	—	—	—	—	1	1	1	—	—	—
<i>Procavia capensis</i>	2	—	—	1	1	1	1	1	1	—	1	1	1	—	1	1	1	1	2
<i>Diceros bicornis</i>	—	—	—	—	—	1	—	—	1	—	1	—	—	1 cf.	—	1 cf.	—	—	—
Rhinocerotidae gen. et sp.	1	—	—	—	1	1	—	1	1	—	1	?1	—	1	1	1	1	—	1
<i>Equus cf. quagga</i>	—	—	—	—	—	—	—	—	1	—	1	1	1	1	2	1	2	—	2
<i>Equus cf. capensis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
<i>Potamochoerus porcus</i>	1	2	2	2	2	1	1	—	1	1	—	—	1	—	1	?1	—	—	—
<i>Phacochoerus aethiopicus</i>	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Suidae, general	1	2	2	2	2	1	1	1	1	1	—	1	2	1	1	1	1	1	1
<i>Hippopotamus amphibius</i>	1	—	—	—	1	1	1	—	—	—	—	—	1	—	—	—	—	—	—
<i>Raphicerus melanotis</i>	4	2	—	3	16	4	1	—	—	—	—	1	—	1	—	1	—	—	—
<i>Raphicerus campestris</i>	3	—	—	1	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Raphicerus spp.</i>	9	4	4	8	25	9	6	5	5	3	1	3	2	4	2	2	2	—	2
<i>Oreotragus oreotragus</i>	3	—	—	—	3	—	—	—	1	—	—	1	—	—	—	—	—	—	2
<i>Pelea capreolus</i>	—	—	—	1	—	1	—	1	—	—	—	—	—	1	—	—	—	—	—
<i>Redunca arundinum</i>	—	—	—	—	—	1	—	—	—	1	—	2	—	1	1	1	—	—	1
<i>Redunca fulvorufula</i>	1	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—
<i>Hippotragus spp.</i>	—	—	—	1	2	—	—	1	1	2	1	—	4	1	—	1	—	—	4
<i>Damaliscus dorcas</i>	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	1	—	1
<i>Connochaetes/Alcelaphus</i>	3	1	—	—	2	—	1	—	1	1	2	3	5	3	4	1	1	2	4
<i>Taurotragus oryx</i>	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	1	—	2
<i>Syncerus caffer</i>	6	1	2	—	4	3	3	3	7	1	1	1	1	2	—	—	1	1	4
<i>Ovis aries</i>	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bovidae, general																			
Small	12	4	4	9	28	9	6	5	6	3	3	4	2	4	2	2	2	1	4
Small medium	12	1	1	1	1	1	1	1	2	1	1	1	2	2	—	1	1	—	2
Large medium	3	1	1	1	4	2	1	1	2	3	4	5	9	7	5	3	2	2	10
Large	6	1	2	2	4	3	5	3	7	1	1	1	1	2	1	2	2	1	6
Leporidae gen. et sp.	1	1	—	—	—	?1	—	1	2	1	1	—	1	1	1	1	3	1	1
<i>Hystrix africae-australis</i>	1	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	1	—	—
<i>Bathyrgerus suillus</i>	37	6	5	19	49	12	5	4	5	1	2	2	1	2	2	6	4	—	12
Total (excl. <i>H. sapiens</i>)	90	18	18	43	105	39	24	21	31	14	17	18	24	29	18	22	22	7	44
AD/m ³	35	32	72	47	85	46	30	36	30	25	60	32	53	38	30	35	39	11	45

Note. The table, with the exception of the totals and ADs, was compiled by R. G. Klein. Genus/family totals include individuals already listed under species.

TABLE 16

Mammals: minimum numbers of individuals in adult and juvenile age groups, as represented by fused/unfused epiphyses (see Appendix 1).

	Adult	Juvenile	Indet.	Total
<i>Ictonyx striatus</i>	2	—	—	2(0)
<i>Mellivora capensis</i>	1	—	1(1)	2(1)
<i>Aonyx capensis</i>	1	—	1	2(0)
<i>Herpestes ichneumon</i>	2	—	3(1)	5(1)
<i>H. pulverulentus</i>	3	1	6(2)	10(2)
<i>Felis libyca</i>	1	—	8(3)	9(3)
<i>F. cf. caracal</i>	2	—	3	5(0)
<i>Arctocephalus pusillus</i>	3	3(1)	9(6)	15(7)
<i>Procavia capensis</i>	4(2)	3(1)	11(6)	18(9)
Suidae—general	—	1	22(10)	23(10)
<i>Raphicerus</i> spp.	47(10)	29(7)	20(4)	96(21)
<i>Oreotragus oreotragus</i>	3(1)	4(1)	3(1)	10(3)
Bovidae—small medium	18(7)	10(4)	4	32(11)
—large medium	19(9)	7(4)	40(37)	66(50)
—large	18(9)	5	28(9)	51(18)
Leporidae—general	4(3)	—	13(8)	17(11)
<i>Hystrix africae-australis</i>	—	1	4(2)	5(2)
<i>Bathyergus suillus</i>	75(11)	61(12)	38(9)	174(32)
Total	203(52)	125(30)	214(99)	542(181)

Note. Numbers in parentheses indicate the numbers of individuals in layers 10–19.

TABLE 17

Mammals: comparison of frequencies in size classes in upper and lower layer groups.

Layers:		1–9		10–19	
		no.	%	no.	%
Very small (<10 kg)	<i>Ictonyx</i> , <i>Herpestes</i> , <i>Atilax</i> , <i>Felis</i> (<i>libyca</i>), <i>Procavia</i> , Leporidae, <i>Bathyergus</i>	177	45,5	59	27,4
Small (10–25 kg)	<i>Canis</i> , <i>Mellivora</i> , <i>Aonyx</i> , <i>Felis</i> (<i>caracal</i>), <i>Raphicerus</i> , <i>Oreotragus</i> , <i>Hystrix</i>	99	25,4	33	15,3
Small medium (25–100 kg)	<i>Papio</i> , <i>Hyaena</i> , <i>Panthera</i> , <i>Arctocephalus</i> , <i>Potamochoerus</i> /Suidae (excl. <i>Phacochoerus</i>), <i>Pelea</i> , <i>Redunca</i> , <i>Ovis</i>	52	13,4	31	14,4
Large medium (>100 kg)	<i>Equus</i> (cf. <i>quagga</i>), <i>Phacochoerus</i> , <i>Hippotragus</i> , <i>Damaliscus</i> , <i>Connochaetes</i> / <i>Alcelaphus</i>	17	4,4	63	29,3
Large (>500 kg)	<i>Equus</i> (cf. <i>capensis</i>), <i>Taurotragus</i> , <i>Syncerus</i> ...	33	8,5	18	8,4
Very large (>1 000 kg)	<i>Loxodonta</i> , <i>Diceros</i> /Rhinocerotidae, <i>Hippopotamus</i>	11	2,8	11	5,1

the smallest size class. It is perhaps worth noting that the ratio of identified adults to juveniles is almost the same in the upper and lower layers: 1,6:1 in the lower layers, 1,7:1 in the upper. There is thus less than a two per cent increase in the relative frequency of identified juveniles in the upper layers. The size classes for 'Bovidae, general' in Table 16 follow Brain (1974, table 2) and these are the same as those used in Table 17, *Ovis aries* being included in the small medium class on the basis of comparative modern data.

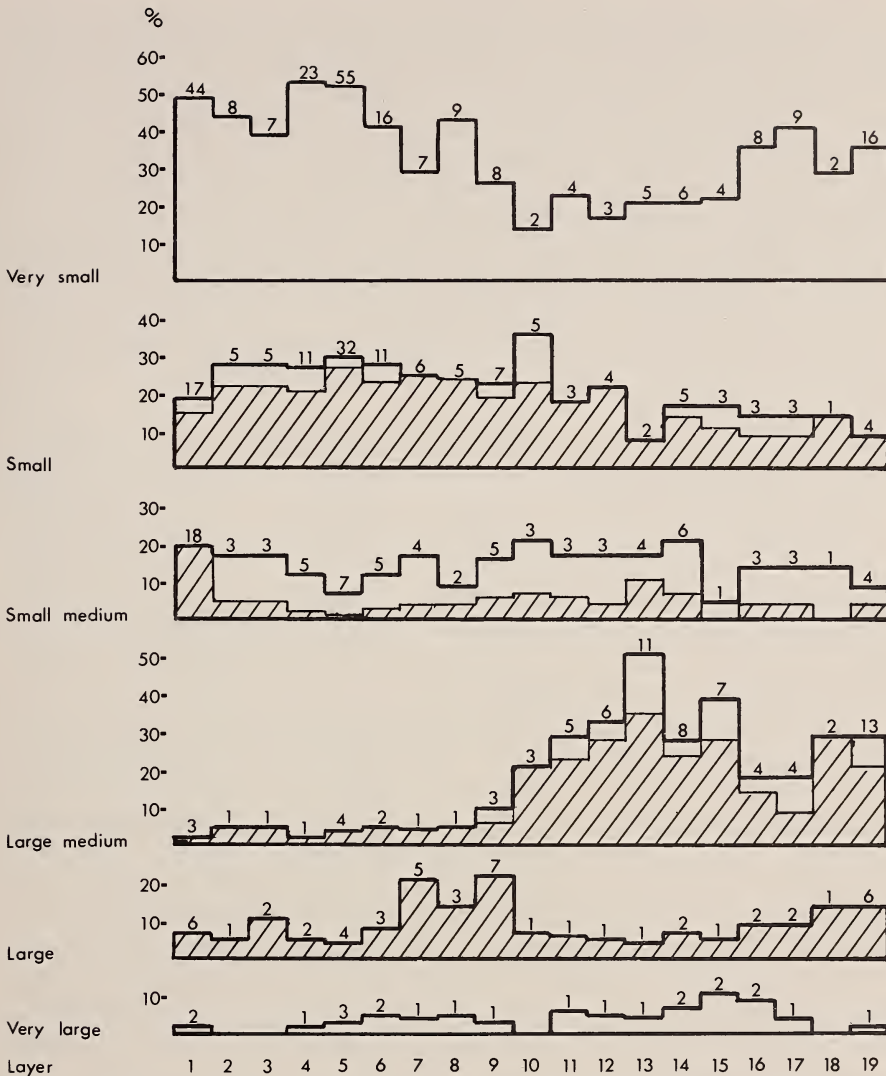


Fig. 39. Histograms of percentage frequencies, by layer, of mammal size classes. Hatched areas indicate bovids, unhatched areas other mammals. Numbers above each column are actual frequencies.

Arctocephalus pusillus has also been included in the small medium size class although only three of the fifteen individuals have been identified as juveniles. The assumption that few, if any, fully-grown individuals are represented is subjective but receives some tenuous support from the data from Elands Bay Cave (Parkington 1972: 239-241; 1976, figs 3-4, 8). In any event, since frequencies in the upper and lower layers are about the same (8:7), the range of error for each group may also be about the same.

The most notable difference between the upper and lower layers is in the large medium size class, which drops from 29,3 per cent of the layer group total in the lower layers to 4,4 per cent in the upper. Making allowance for the fact that both *Equus* species are now extinct and that *Hippotragus* and *Connochaetes/Alcelaphus* have not been identified as to species, the animals in this size class may be described broadly as gregarious grazers with a preference for open or lightly wooded grassland (Dorst & Dandelot 1972: 159–165, 174, 204–205, 221–222, 227–228, 230–232 for comparable species, where applicable). *Equus* cf. *capensis*, *Phacochoerus aethiopicus*, and *Damaliscus dorcas* are restricted to the lower layers, *Equus* cf. *quagga* is not present after layer 9, and, although *Hippotragus* spp. and *Connochaetes/Alcelaphus* are present in the upper layers, their frequencies are markedly reduced by comparison with the lower layers (Table 15).

There is no significant change in the relative frequency of the large size class, but that of the very large size class is reduced in the upper layers to about 55 per cent of the relative frequency in the lower layers, even though the actual counts are the same. There is no significant change in the relative frequencies of the small medium class (a 7% reduction in the upper layers) but, whereas the combined frequency of the small and very small size classes in the lower layers is 42,7 per cent of the total for these layers, in the upper layers the very small size class alone accounts for 45,5 per cent of the total and the two size classes combined make up 70,9 per cent.

The indications are, then, that in the upper layers there was a marked shift away from the procurement patterns of the lower layers, with more animals in the smaller size classes and fewer in the larger being obtained in the upper layers than was the case in the lower. An approximate calculation of the total live mass of the individuals, excluding the very large size class, suggests that there was a marked reduction in the total mass procured in the upper layers, especially when comparisons are made on an AD basis. The estimated total live mass for the upper layers, 31 972 kg, is only about 10 per cent higher than that for the lower layers, 29 154 kg, but the AD for layers 9–1 is 3 625 while that for layers 19–10 is 4 827, 33 per cent higher than the AD for the upper layers. Allowance should also be made for a higher proportion of inedible residue in small animals than in large, relative to their total mass.

Although no great confidence can be attached to such calculations, based as they are on approximations and imponderables, they do allow the suggestion that the increase in the number of animals procured during the second half of the occupation of the cave was not sufficient to provide the same amount of meat as had been procured during the first half.

Although most of the layer totals are so small as to make it of dubious value to convert them to percentage frequencies, especially when they are divided among the six size classes, to do so can have some use in indicating change on a smaller scale than the bipartite division into lower and upper layers. Figure 39 presents in histogram form the percentage frequencies of each

of the six size classes in the individual layers and, while this shows that there is some justification for the bipartite division, it also shows that there are variations that transcend this division. As is general in this report, however, the emphasis is on the study of trends rather than of layer-by-layer variation.

In the very small size class two major trends are discernible, a decline in relative frequencies from layer 19 to layer 10 and an increase in the overlying layers, at least up to layer 4. The decline in layer 3, followed by increases in layers 2 and 1, is not easy to interpret on the basis of the mammalian fauna alone. It may in some way be related to the marked increase in the frequency of marine shell in this layer, which is discussed in the following section.

The small size class shows a generally increasing trend from layer 19 to layer 5, followed by relatively similar frequencies in layers 4–2 and a decline in layer 1.

The pattern of variation in the small medium size class is more complex than those of the two preceding size classes. It is possibly most simply interpreted as showing lower relative frequencies in layers 19–15 than in layers 14–10, an erratically declining trend in layers 9–5 and an increasing trend in layers 4–1.

The large medium size class also varies erratically in the lower layers but the trends may be interpreted broadly as increasing to layer 13 then decreasing to layer 8, after which frequencies are stable but low. The cyclic trend in layers 19–9 is a factor that would have been overlooked had the simple bipartite division been the only method of comparing the content of the layers.

The large size class, which consists entirely of bovids, shows a mildly declining trend in layers 19–13, an increasing trend to layer 9 and thereafter minor fluctuations to the end of the sequence.

The very large size class has very low frequencies, both actual and relative, and such fluctuations as are evident in Figure 39 are not considered significant.

Perhaps the most important trends are the increase in the relative frequency of large medium animals up to layer 13, that is, until the early Holocene, after which they decline until by layer 9, some 6 000 years ago, they are no longer an important factor. The consistent increase in the relative frequency of small animals is one that transcends the bipartite division. This and the declining trend in the very small size class up to layer 10 serve to warn against perhaps too simplistic interpretations based on broad groups of layers.

The ratio of bovids to other animals is equal in layer 19, higher in layers 18, 14–9, and 7 but lower in layers 17–15, 8, and 6–1. This indicates that there was only one main period, from about 10 000–6 000 B.P., when bovids were more common than all other animals brought back to the site. With the exception of *Oreotragus oreotragus* and *Taurotragus oryx*, which are browsers, and *Raphicerus* spp. and *Redunca fulvorufula*, which are mixed grazers–browsers, the bulk of the indigenous bovids are primarily grazers (Dorst & Dandelot 1972). Including the equids, there are more grazers in layers 19–9 than browsers or mixed feeders, except in layer 16, in which the ratio is equal,

as is the case in layer 8. In layers 7-1 there are more browsers and mixed feeders than grazers.

SHELLFISH

Remains of close on 25 000 identifiable individual shellfish were recovered. As the inventory in Table 18 indicates, shell was recovered from every layer, but the increase in frequency from layer 9 up is in the range of at least one order of magnitude. As is usual in this report, the marked difference in the frequencies of the lower and upper layers causes them to be treated as separate units, with the major emphasis inevitably given to the upper layers. In the case of the shellfish, layers 9-1 contain 98,6 per cent of the total of identifiable individuals.

As mentioned in the discussion of the stratigraphy, layer 3 is virtually a shell midden deposit and was, by virtue of the high density of shell, one of the few clearly definable stratigraphic units. The AD of 12 120 for this layer is more than three times that for layer 2, which has the next highest AD, and ten times that for layer 9. Apart from the anomaly of layer 3, however, the ADs given in Table 18 indicate a gradual increase in the frequency of shell throughout the deposit.

The numerical frequencies given in Table 18 represent the minimum numbers of identifiable individuals. The bulk of the shell is fragmented and counts were based on diagnostic features such as head or tail valves for *Dinoplax gigas*, umbones for bivalves, and apices for gastropods, as well as opercula in the case of *Turbo* spp. Where there was more than one diagnostic part, counts were based on the higher frequency of either part.

In several cases counts were made only at genus level, either because of difficulty of identification at species level, or because some genera are represented by a principal species, with only few individuals of other species. The principal *Haliotis* species is *H. midae*, and difficulty was experienced in identifying some of the smaller individuals, which may be either *H. (sanguineum) spadicea* or immature *H. midae*. The *Patella* species are detailed in Table 19 and are discussed later in this section. At least two species of *Burnupena* could be identified, *B. delalandii* and *B. (papyracea) cincta*, but identification of most individuals was not possible at species level due to poor preservation. Because of fragmentation or loss of specific diagnostic features, about three per cent of the mussels, *Choromytilus meridionalis* and *Perna perna*, and about five per cent of the limpets, *Patella* spp. could not be identified at genus and species level respectively.

Turbo sarmaticus, with 31,4 per cent of the site total, is the most commonly represented shellfish at the site and, except for layer 3, dominant in all the upper layers. As indicated in Figure 40, there is a clear secular trend, with frequencies increasing in layers 9-7, then decreasing to layer 3. This is complemented by a reverse trend in the frequencies of *Oxystele sinensis* which decrease in layers 9-7 then increase to layer 3 in which the frequency, 38,8 per

TABLE 18
Shellfish: inventory of species/genera.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	site total
<i>Dinoplax gigas</i>	284	17	17	26	28	11	15	21	12	2	—	—	—	—	—	1	—	—	1	437
<i>Choromytilus meridionalis</i>	1 295	19	11	64	197	69	19	51	117	10	4	11	—	9	3	4	3	3	2	1 891
<i>Perna perna</i>	76	30	33	44	51	13	12	35	35	1	1	—	—	—	—	1	—	—	—	332
<i>Choromytilus/Perna</i> indet.	7	—	—	—	16	5	9	6	15	4	—	1	1	—	—	—	—	—	1	65
<i>Choromytilus-Perna</i> total	1 378	49	44	108	264	87	40	92	167	15	5	12	1	9	3	5	3	3	3	2 288
<i>Donax serra</i>	147	3	5	6	45	110	55	41	69	18	22	41	3	21	4	14	2	—	1	607
<i>Haliotis</i> spp.	25	4	6	25	82	55	21	21	19	1	1	—	1	—	—	1	—	—	—	262
<i>Patella</i> spp.	397	219	300	252	533	339	194	190	157	7	5	3	1	—	2	2	—	—	—	2 601
<i>Turbo citaris</i>	649	322	330	349	563	409	207	164	260	14	3	1	1	1	—	1	—	—	—	3 274
<i>T. sarmaticus</i>	2 040	767	699	665	1 200	955	610	462	285	43	7	7	2	1	—	3	1	—	8	7 755
<i>Turbo</i> spp. total	2 689	1 089	1 029	1 014	1 763	1 364	817	626	545	57	10	8	3	2	—	4	1	—	8	11 029
<i>Oxyspela sinensis</i>	1 880	418	1 177	590	417	68	19	36	102	3	4	1	—	—	1	—	—	—	2	4 718
<i>Burnupena</i> spp.	876	302	452	267	431	112	82	110	122	3	1	—	1	—	1	1	—	—	1	2 762
Other	6	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	1	16
Layer total	7 682	2 101	3 030	2 288	3 563	2 146	1 243	1 137	1 195	106	48	67	10	32	12	28	7	6	19	24 720
AD/m ²	2 954	3 686	12 120	2 514	2 873	2 555	1 535	1 960	1 172	189	171	120	22	42	20	45	12	9	19	

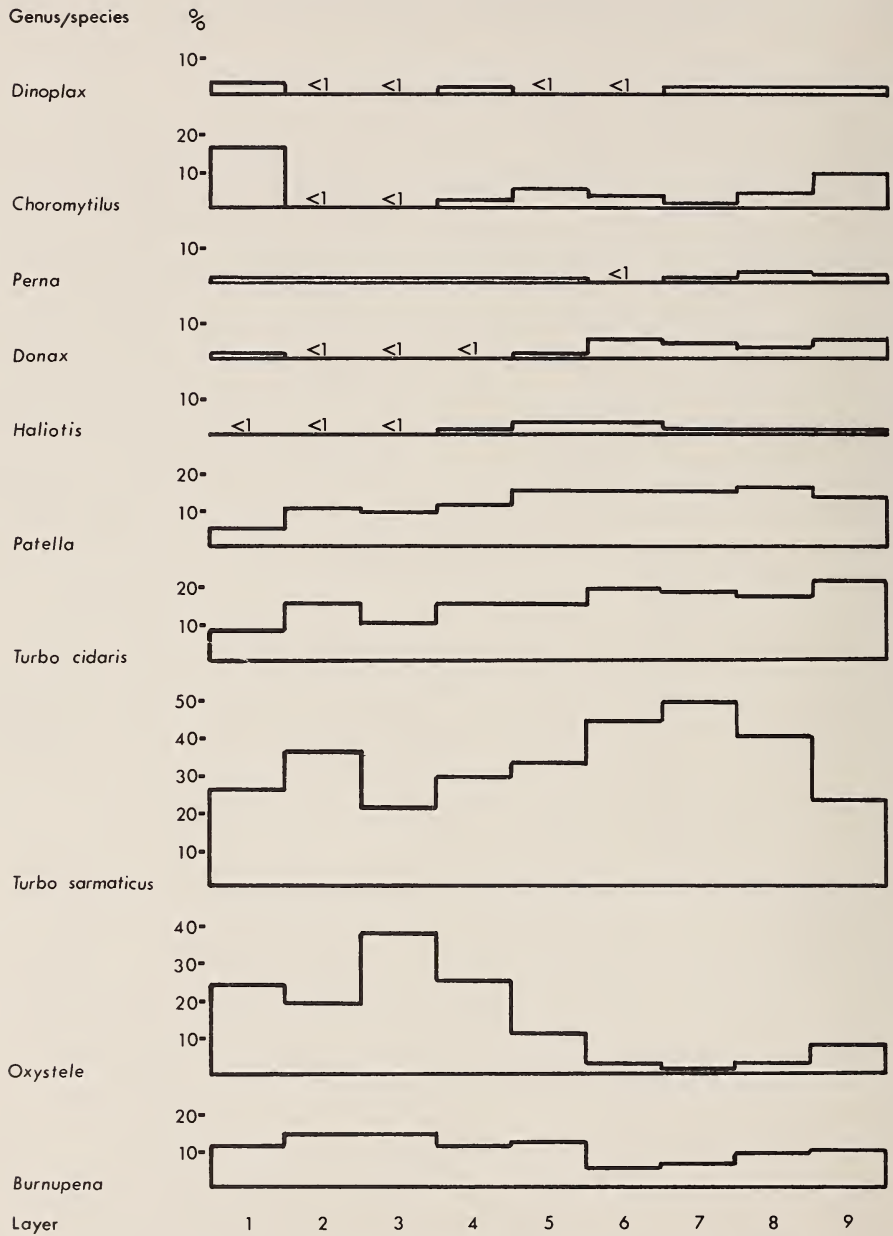


Fig. 40. Histograms of percentage frequencies, by layer, of major shellfish genera/species in layers 1-9. <1 = less than 1 per cent of the layer total.

cent of the layer total, exceeds that of *Turbo sarmaticus* (23,1%). *Oxysteles sinensis* is much smaller than *Turbo sarmaticus* and nearer the size of *T. cidaris* so that the increase in the frequency of *Oxysteles sinensis*, measured against the decrease in that of *Turbo sarmaticus*, cannot be seen simply as the replacement of one food resource by another.

The frequencies of *Patella* spp., *Turbo cidaris*, and *Burnupena* spp. are all under 20 per cent of individual layer totals. *Patella* frequencies are stable in layers 8–5 but decline thereafter, while those for *Turbo cidaris* increase in layers 8–6 then decrease to layer 3, and those for *Burnupena* spp. decline in layers 9–6 and increase to layer 3.

Frequencies of the other genera are all low and do not call for any special comment except in the case of *Choromytilus meridionalis* which, with frequencies ranging from less than 10 per cent of the layer total in layers 9–4 and less than one per cent in layers 3 and 2, increases quite markedly in layer 1 to 16,9 per cent of the layer total.

As mentioned in the preliminary report on BNK 1 (Schweitzer & Wilson 1978: 137) *Donax serra* is not considered to have been collected by the cave occupants primarily for its food value. *D. serra* artefacts in the form of perforated shells used as ornaments and edge-damaged fragments ('scrapers') have already been discussed, as has the use of these shells for decorating pottery, but since the use of this shellfish for food prior to the use of the shell for ornaments or tools cannot entirely be discounted, frequencies of unmodified valves are included in Table 18. It is of some interest that, although frequencies of all shell in the lower layers are so low as to be statistically negligible, *D. serra* is the most common shell in these layers, as is also the case with artefactual shell (Table 12).

The category 'other' consists of 9 valves of the surf-clam *Scissodesma spengleri* from layers 1, 9 and 17–19, 5 valves of the freshwater mussel *Cafferia caffra* from layers 1 and 9, and two unidentifiable fragments, probably of oyster *Ostrea* sp(p). from layers 1 and 15. Although no actual localities are known in the vicinity of BNK 1 where *Cafferia caffra* is to be found today, it seems likely that it was obtained from the Uilkraals River. Fragments of the razor-shell or pencil-bait *Solen capensis* were recovered from layers 2, 5–6, and 9–10 but because of the high degree of fragmentation and a general lack of diagnostic parts counts were not made. There were probably not more than two or three in any layer.

Interest has been shown by archaeological researchers working on the Cape west coast (e.g. Parkington 1976; Robertshaw 1977, 1978, 1979; Buchanan *et al.* 1978) in changes in shellfish sizes as possible indicators of the effect of human predation on shellfish populations. It has been considered that a diminution in the size of genera such as *Choromytilus* and *Patella* in successive layers of midden deposits is an indication of the 'farming down' of shellfish populations, with continuous collecting preventing the shellfish from reaching maximum growth.

TABLE 19
Shellfish: inventory of *Patella* species.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	species total
<i>P. argenvillei</i>	30	17	20	34	63	36	12	7	6	1	1	1	1	—	—	—	—	—	—	229
<i>P. barbara</i>	4	2	—	1	6	1	1	2	2	—	—	—	—	—	—	—	—	—	—	19
<i>P. cochlear</i>	13	4	19	20	18	21	23	34	17	1	—	—	—	—	—	—	—	—	—	170
<i>P. compressa</i>	2	—	—	2	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	6
<i>P. granatina</i>	74	21	25	64	94	72	55	28	33	2	1	2	—	—	—	—	—	—	—	471
<i>P. granularis</i>	5	4	6	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	19
<i>P. longicosta</i>	135	112	153	76	290	181	87	76	69	3	3	—	—	—	—	1	—	—	—	1 186
<i>P. miniata</i>	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
<i>P. oculus</i>	93	33	50	37	49	24	12	19	21	—	—	—	—	—	—	1	—	—	—	339
<i>P. tabularis</i>	2	2	—	2	3	—	—	4	2	—	—	—	—	—	—	—	—	—	—	15
Indet.	37	23	27	14	8	3	4	19	7	—	—	—	—	—	2	—	—	—	—	144
Layer total	397	219	300	252	533	339	194	190	157	7	5	3	1	—	2	2	—	—	—	2 601
AD/m ⁵	153	384	1 200	277	430	404	239	328	154	12	18	5	2	—	3	3	—	—	—	—

The *Choromytilus meridionalis* samples from BNK 1 are too fragmented to provide numbers of unbroken shells adequate for metrical analysis. The same is true of the *Patella* species, though to a lesser extent. An inventory of the species is provided in Table 19 and percentage frequencies in histogram form in Figure 41. All the unbroken shells from layers 1 to 9 were measured and the length data are presented diagrammatically in Figure 42. The numerical data for the sample sizes given in this figure indicate that the frequency of unbroken shells in any layer ranges from 38 to 57 per cent of the total of identifiable *Patella* in the layer. It was not possible to estimate the lengths of the broken shells and it is thus not certain whether there is any bias in the sample, perhaps towards the preservation of larger shells.

Branch (1971, 1974a, 1974b) has published details of his research into the ecology of modern *Patella* populations on the coasts of the Cape Peninsula, and these provide useful parameters for the analysis of samples from archaeological deposits. Since Branch studied populations on both the warmer False Bay coast and the colder Atlantic coast, it would seem legitimate to use his data for comparison with the samples from BNK 1, since the coast from which the shellfish were probably collected lies within what Stephenson (1944: 297) has termed the 'western overlap', an area in which the marine life is affected, to varying degrees in different localities, by both the warm waters of the Agulhas Current and the cold waters of the Benguela Current.

Branch (1974b, figs 13–14, 16–17) has given the population structure of the *Patella* species with which Figure 41 is concerned, except *P. argenvillei* which, in any case, is inadequately represented in the BNK 1 sample. The data contained in Branch's histograms have been used to provide a basis for comparison with the archaeological samples and are included in Figure 42. The frequencies of most of the BNK 1 layer samples of the five species are too low for them to be amenable to valid testing of statistical significance and the data are generally useful only for comparison at a broad level.

P. argenvillei, for which no comparative data are given by Branch, is present in low frequencies. These indicate little change in mean length in layers 9–5 but a decline in layers 4–2, layer 2 having the lowest mean length of all the layers. The mean length for layer 1 is closer to the means for layers 9–5 than to those for the intervening layers.

P. cochlear has mean lengths in layers 9–4 that are close to the mean length of the total modern population, while those in layers 2 and 1 are closer to the mean for the population of individuals 20 mm or longer (hereafter called the larger modern population). There is a mildly increasing size trend in layers 8–4 but layer 3 has the lowest range and mean of all the layers, and the mean is also lower than that for the total modern population.

P. granatina has mean lengths in the archaeological samples that are mostly well beyond those for the modern population. The mean length increases in layers 9–7, decreases in layers 6–3 and increases again in layers 2

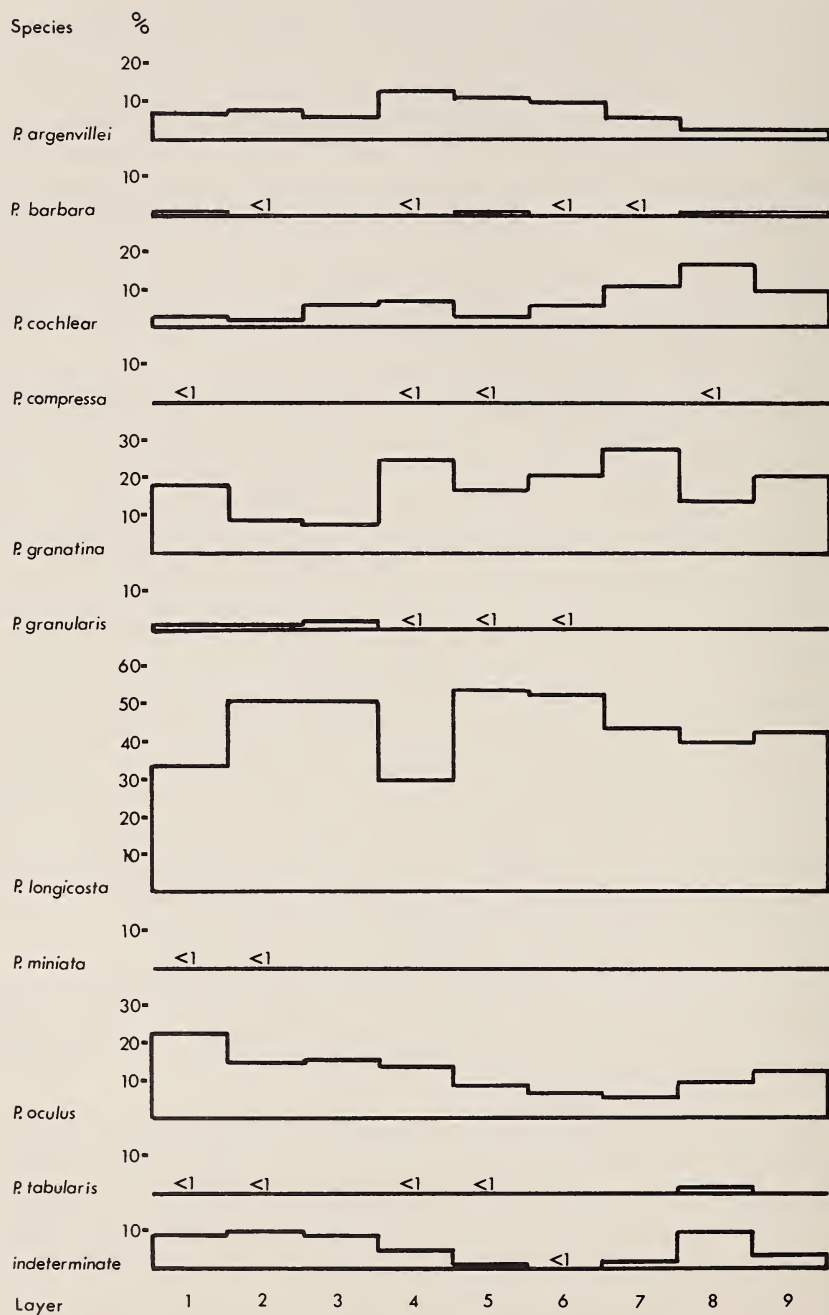


Fig. 41. Histograms of percentage frequencies, by layer, of *Patella* species in layers 1-9.
 <1 = less than 1 per cent of the layer total.

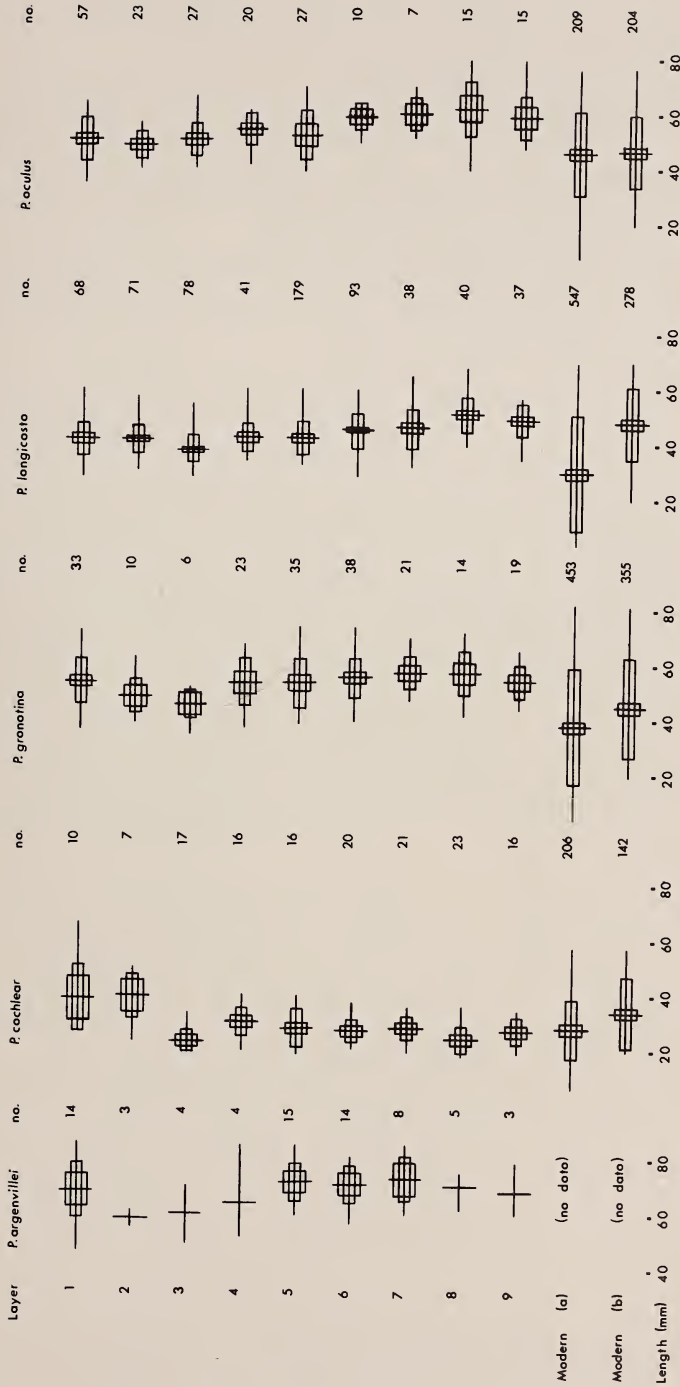


Fig. 42. Modified Dice-Leraas diagrams of lengths of unbroken *Patella* shells from layers 1-9 with comparative data for modern populations from the Cape Peninsula (after Branch 1974b, figs 13-14, 16-17). The diagrams for the modern population are (a) for the whole population and (b) for individuals 20 mm or longer. Numbers to the right of each diagram indicate the number of individuals in each sample. For explanation of symbols, see Figure 8.

and 1. Layer 3 again has the lowest mean of all the layer samples though this is still somewhat higher than that for the larger modern population.

P. longicosta is in general the only species with individual layer samples that are large enough to be statistically reliable. The mean length in layers 9–5 is closer to that of the larger modern population but in layers 4–1 it is intermediate between this and the mean for the total modern population. The mean length declines in layers 8–3 but increases again in layers 2 and 1, and it is again layer 3 that has the lowest mean of all the layers.

P. oculus has mean lengths greater than those of the modern population. These show a gradually declining trend in layers 8–2 while the mean length for layer 1 is the same as that for layer 3. This species, like *P. argenvillei*, has the lowest mean in layer 2 rather than in layer 3.

Branch's population data indicate that almost 70 per cent of the *P. cochlear* population is less than 30 mm long. The *P. granatina* population distribution, on the other hand, is bimodal, with a distinct falling-off in frequency between about 35–55 mm. About 58 per cent of the population is smaller than 35 mm and about 32 per cent larger than 55 mm. In the case of *P. longicosta* almost half the population is less than 20 mm long and only 25 per cent is longer than 50 mm. Less than 15 per cent of the *P. oculus* population is less than 30 mm long and just over 60 per cent is in the 40–60 mm range.

The indications of the BNK 1 samples are, therefore, that collecting was generally directed at the larger-sized individuals, although in the case of *P. cochlear* it appears that, except in layers 2 and 1, it was the whole population that was being exploited. That layer 3, which has the highest relative frequency of shell, also has the lowest mean lengths for three of the five species may be indicative of heavy human predation, although the low frequencies of all the species except *P. longicosta* suggest that such an inference be treated with caution.

Unless preservation factors are involved, the virtual absence of individuals under 20 mm long can probably be explained by their being too small to be worth the effort of collecting. Moreover, Branch (1971) points out that the juveniles of several species make their homes on the shells of larger individuals of the same or other species, also on *Oxystele sinensis* or *Pyura* (red-bait). The small individuals drop off almost immediately if the host is inverted. A probable explanation of the scarcity of the largest individuals is that they are comparatively scarce in the population structure (cf. Branch 1974b, figs 13–17). In many cases, too, the larger individuals tend to occupy zones of deeper water, though this is species-dependent (Branch 1971). In this connection, it is worth noting that the species most common in the BNK 1 samples, *P. granatina*, *P. longicosta*, and *P. oculus*, are those that occupy the higher littoral zones (Branch 1971, figs 3–4). The virtual absence of *P. granularis*, described by Branch (1971: 7) as 'probably the most widespread as regards vertical and horizontal distribution', can possibly be explained by the fact that the bulk of the modern population is less than 30 mm long (Branch 1974b, fig. 15) and

might not have been worth the effort of collecting in an area in which larger individuals of other species were readily available. The bulk of the *P. cochlear* population is, however, also mostly under 30 mm long and is much less accessible than *P. granularis*, which occupies the highest littoral zone of all the *Patella* species (Branch 1971, figs 3–4).

Branch (1974b: 182) names *P. longicosta* as one of several *Patella* species in which the size decreases as the mean sea temperature increases. Given the relatively long period of time, almost 2 500 years, spanned by layers 8–3, it is possible that the decreasing length of this species in these layers may reflect a gradually increasing sea temperature rather than the effects of human predation. On the other hand, in layers 6–4 the minimum length of the samples measured increases while the maximum length remains constant. This appears contrary to any indication that the overall length of the population was, for whatever reason, diminishing.

Stephenson (1944: 316) and Branch (1971: 11) describe *P. oculus* as the warm-water ecological counterpart of *P. granatina*, which has the eastern limit of its habitat in the Agulhas region. Although the *P. granatina* frequencies in the BNK 1 samples are variable, up to layer 4 they are consistently higher than those of *P. oculus*, which then becomes the more common species (Fig. 41, Table 19). If the decreasing mean length of *P. longicosta* in layers 8–3 is taken as indicative of an increasing sea temperature, the increasing frequencies in layers 9–5 of *P. granatina*, which has a preference for cold water, cannot be taken to indicate a decreasing sea temperature during the same period. It may, however, be of some relevance that the *P. granatina*:*P. oculus* ratio drops from about 4.4:1 in layer 7 to 1:2 in layer 3 and the decline continues in layers 2 and 1. However, although the relative frequencies of these two species do show an inversion, and the frequency of *P. oculus* also increases constantly in layers 7–1 relative to all other species (Fig. 41), the mean and maximum lengths show a more or less constant decline in layers 8–2 (Fig. 42), whereas in an increasing sea temperature they should be expected to increase.

It would seem, then, that the data derived from the measurement of the length of the BNK 1 *Patella* samples do not lend themselves to the extrapolation of inferences regarding past changes in sea temperatures. This is not surprising, considering the number of variables involved, of which perhaps one of the most important is the probable collecting area. There is an upwelling of cold water at Danger Point (Branch 1979 pers. comm.) and changes in the littoral ecology could result from shifts in the flow of this water without it being necessary to invoke an overall change in mean sea temperature. Branch (1979 pers. comm.) has pointed out that a localized predominance of *P. longicosta* or *P. granatina* is a common occurrence on the False Bay coast, depending on where there are up-wellings of cold water.

Layer 3, with the highest AD of all the layers, for *Patella* as well as other genera, generally has the smallest sizes of all the *Patella* species other than *P. argenvillei* and *P. oculus*, for which the lowest means and maxima are in

layer 2. By contrast, layer 1, which shares with layer 9 the lowest AD for *Patella*, tends to have higher means and ranges for most of the species. While it might be expected that more intensive predation, as indicated by the layer 3 frequencies, would result in a lowering of the mean size of the shellfish collected, less intensive predation, as suggested by the layer 1 frequencies, could be expected to result in greater selectivity, with fewer small individuals but, except for *P. cochlear*, this does not seem to have been the case. A possible interpretation is that predation was as intensive as in layer 3 times but with more, and possibly smaller, human groups competing for the same set of resources. This could have had the effect of fewer *Patella* being brought back to BNK 1 but these covering a wider, less selective, range of sizes.

In addition to the fact that the layer frequencies of the five *Patella* species are, apart from *P. longicosta*, too low to provide reliable data, it is felt that the chronology of the upper layers is too extended and contains an insufficient number of dates for any indications of changes in shell length to be capable of being interpreted as evidence of the effects of human predation. The life-span of the *Patella* species ranges from 2 to 3 years for *P. oculus* to 15 to 25 years for *P. cochlear* (Branch 1974b, table 3). The upper layers of BNK 1 span some 6 000 years, of which about half is covered by layer 1 alone, and even the span of 200 years or so between the oldest date for layer 1 and that for layer 2 covers from several to many lifetimes of the various species.

It must be concluded, therefore, that although the shellfish remains from BNK 1 provide evidence of an increasing reliance on this food resource, from at least layer 9 on the layer samples, together with their chronology, do not lend themselves to the extrapolation of inferences regarding changes in sea temperatures or the effects of human predation on shellfish populations.

FISH

Fish remains were recovered from all layers except 16 and 18. These were identified by C. E. Poggenpoel and are listed in Table 20.

As indicated in the inventory, there is a marked increase in frequencies from layer 9 up, although these are still low. The ADs indicate rather more clearly than the actual frequencies the progressive increase up to layer 5, after which frequencies decline. It is of interest to note that there is an approximate correlation between the number of genera and the number of individuals, with an increase in the number of individuals corresponding with an increase in the number of genera.

Pachymetopon blochii, with 37,4 per cent of the site total, is the most commonly represented fish, followed by the combined totals for *Lithognathus* spp. (16,5%) and *Rhabdosargus globiceps* (15,8%). *Pachymetopon blochii* generally lives among kelp (*Ecklonia maxima*, *Laminaria pallida*) growing in deeper water off rocky shores, while the other two genera favour sandy areas and may be found off estuaries.

TABLE 20
Fish: inventory of species.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	species total	% site total
<i>Pomatomus saltator</i>	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.4
<i>Argyrosomus hololepidus</i>	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	2	0.7
<i>Coracina capensis</i>	—	—	—	1	3	11	2	1	—	—	—	—	1	—	—	—	—	—	—	19	7.2
<i>Rhabdosargus globiceps</i>	1	1	1	4	16	5	2	3	6	1	—	—	—	1	—	—	1	—	—	42	15.8
<i>Diplodus sargus</i>	—	—	—	—	—	1	1	—	3	1	—	—	—	—	—	—	—	—	—	6	2.3
<i>Lithognathus lithognathus</i>	3	2	1	3	13	4	2	1	3	—	—	1	—	—	—	—	—	—	—	33	12.4
<i>L. mormyrus</i>	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1.1
<i>Lithognathus</i> spp.	—	1	—	—	1	1	2	3	—	—	—	—	—	—	—	—	—	—	—	8	3.0
<i>Pachymetopon blochii</i>	3	5	5	13	34	24	6	3	4	2	—	—	—	—	—	—	—	—	—	99	37.4
<i>Argyrozona argyrozona</i>	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	0.4
<i>Liza richardsoni</i>	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1.1
Unidentified	3	1	—	—	32	—	7	—	—	—	1	—	1	—	1	—	1	—	1	48	18.1
Layer total	10	11	7	22	105	48	21	12	16	4	1	1	2	1	1	—	2	—	—	1	265
% site total	3.8	4.1	2.6	8.3	39.6	18.1	7.9	4.5	6.0	1.5	0.4	0.4	0.7	0.4	0.4	—	0.7	—	0.4	—	—
AD/m ³	4	19	28	24	85	57	26	20	16	7	3	2	4	1	2	—	3	—	—	1	—

Local informants (M. & J. Kemp 1979 pers. comm.) have advised that there are areas between Die Kelders and Pearly Beach where certain genera are more commonly caught. Apparently this does not depend on a simple distinction between rocky shore and sandy beach, and may also have to do with off-shore currents and localized up-wellings of cold water. *Pachymetopon blochii* is more common on the Walker Bay coast between Die Kelders and Danger Point, *Diplodus sargus* at Die Kelders, *Coracinus capensis*, *Argyrosomus hololepidotus* and *Lithognathus* spp. at Die Gruis, a rocky outcrop fronting a sandy shore between Uilkraalsmond and Pearly Beach, while Mugilidae are best caught at Romansbaai between Gansbaai and Danger Point, and at Uilkraalsmond, which is also a favourable locality for *Argyrosomus hololepidotus* and *Lithognathus* spp.

From measurements of dentaries, Poggenpoel (1979, fig. 8) has extrapolated the lengths of thirty *Rhabdosargus globiceps* in the BNK 1 sample. Poggenpoel's calculations show that the range of this sample, 170–380 mm, exceeds that of the numerically larger sample from Elands Bay Cave (150–330 mm) as well as those of four modern marine samples (130–350 mm), and is far greater than those of four samples from estuarine environments (25–150 mm). The BNK 1 size range indicates that the fish were taken from the open sea rather than from the Uilkraals estuary, but the maximum length of the sample is well below the largest recorded size of approximately 510 mm (Smith & Smith 1949: 47).

ROCK LOBSTER

Remains of the rock lobster *Jasus lalandii* were not recovered from the deposits, nor were they recorded from Die Kelders (Schweitzer 1979). They are to be found in the area today although they are extremely scarce, except in Gansbaai harbour, as the result of excessive human predation. The possibility of a preservation factor cannot be excluded, although this is unlikely to have been the case at Die Kelders as well as at BNK 1, and the remains are preserved in open midden sites.

BIRDS

Bird remains from the site are being analysed by G. Avery, but the analysis is not yet complete and will doubtless be published elsewhere.

REPTILES

Tortoise counts based on humeri were undertaken by L. Lawrence. The frequencies given in Table 21 represent the minimum numbers of individuals in each layer, based on the higher humerus count, whether left or right. Two species were recognized, the land tortoise *Chersina angulata*, and the water tortoise *Pelomedusa subrufa*, both of which are common in the area today.

A remarkable feature of the deposit was the dense concentration of tortoise remains in layer 14. Like the dense concentration of marine shell in

TABLE 21
Reptiles: inventory of species.

Layer	<i>Chersina angulata</i>	Tortoise <i>Pelomedusa subrufa</i>	AD/m ³ (both spp.)	<i>Pseudaspis cana</i>	Snake* <i>Bitis arietans</i>	indet.	Lizard* <i>Cordylus cordylus</i>	<i>Agama atra</i> (?)
1	261	21	108	5	1	4	—	—
2	52	5	100	10	1	1	—	—
3	62	6	272	1	2	—	—	—
4	65	6	78	1(+)	—	2	—	1
5	184	10	156	5(+)	—	1	5	—
6	150	9	189	4	—	1	—	—
7	57	3	74	1	—	—	—	—
8	52	3	95	1	—	1	—	—
9	168	3	168	1	—	1	—	—
10	82	5	155	1	—	—	—	—
11	45	1	164	1	—	—	—	—
12	136	5	252	1	—	—	—	—
13	65	2	149	1	—	—	—	—
14	234	6	304	—	—	—	—	—
15	61	—	102	—	—	—	—	—
16	63	—	102	—	—	—	—	—
17	32	1	58	—	—	—	—	—
18	30	2	49	—	—	—	1	—
19	75	4	81	—	—	—	—	—
Total	1 874	92		33(+)	4	11	6	1

* Snake and lizard frequencies based on counts from 1974 excavation only.

layer 3, the tortoise remains in layer 14 made it one of the few clearly identifiable stratigraphic units in the deposit and in the 1976 excavation these were removed as a separate sub-unit of layer 14. The concentration is apparently a mound or lens for, although it was found throughout the excavated area, it begins to thin out in square O 30 and probably ends in row 31 or 32. In squares O 29 and O 30, from which the tortoise 'midden' was excavated as a separate sub-unit, the AD is 430 as against 304 for the layer as a whole. Although the layer AD is not markedly higher than those for layers 12 or 3, it is still clear that layer 14 does contain a very high frequency of tortoise remains.

Although tortoise remains are too common in southern African archaeological deposits for their presence at BNK 1 to warrant much comment, the 'midden' in layer 14 does call for some discussion.

In addition to the high frequency of tortoise, layer 14 contains a high number of mammal taxa (Table 15): 21 for a total of 29 individuals, as against 10 taxa for 18 individuals in layer 15 and 15 taxa for 24 individuals in layer 13. R. Rau (1979 pers. comm.) has suggested that an abundance of tortoises is more likely to be indicative of dry conditions than wet. The dense concentration of tortoise remains in layer 14, coupled with the apparent diversification of mammal predation suggested by the high number of taxa that mostly contain only one individual, may be indicative of a period of environmental stress. This is difficult to substantiate, particularly when the relatively high frequency of large medium (grazing) bovids in this layer is taken into account. These are animals that would probably have moved out of the area in a time of drought, although the river area may have provided a refuge. It must also be borne in mind that layer 14 is a composite unit with a depositional history of unknown

length and the tortoise 'midden' is probably a single phase representing an accumulation during one year.

Although the total of tortoise remains in the upper layers is some 28 per cent higher than that in the lower layers, the actual frequencies as well as the ADs do not indicate a pattern of increase through time. Layers 19–17 have lower ADs than most of the overlying layers and those for layers 14–9 are consistently high but in the rest of the upper layers they fluctuate from layer to layer.

Snake remains from the 1974 excavation were identified by G. A. McLachlan. Counts were based mainly on jaws and the fact that these are mostly fragmented accounts for the uncertainty as to the actual numbers of individuals in layers 4 and 5, which are probably higher than the totals given in Table 21.

The molesnake *Pseudaspis cana* is a large non-poisonous snake common in the BNK area today and although it is very fast-moving its lack of venom possibly accounts for its being more common in the deposits than the other identified species, the puff-adder *Bitis arietans arietans*. However, Visser (1979: 9) describes the molesnake as 'a vicious snake, biting fiercely and capable of inflicting serious wounds'. The puff-adder is extremely venomous and possibly even more dangerous because its deliberate movements create a false impression of sluggishness (Visser & Chapman 1978: 35).

That snake remains occur in the BNK 1 deposits only from layer 13 up may be of some significance, indicating yet another aspect of the changing pattern of resource exploitation from that of the lower layers to that of the upper. It may also be part of this changing pattern that resulted in layers 14–9 having consistently high frequencies of tortoise and provides a further instance of the arbitrariness of the division of the deposit into lower and upper layer groups because of the generally higher frequencies of most components of the artefacts and fauna in the upper layers.

The two species of lizard occur so infrequently that beyond recording their presence and observing that this need not be related to human activity in the cave, no further comment seems necessary.

MICROMAMMALS: PALAEOENVIRONMENTAL INTERPRETATION

The micromammalian fauna from BNK 1 were analysed by D. M. Avery (1979: 123–127, 174–177, 197–199). Modern comparative samples were collected from the overhang below BNK 1, designated BNK 2 by Avery (Fig. 2 herein), and from an owl roost near Stanford (Fig. 1 herein).

On the basis of her analysis Avery was able to divide the BNK 1 deposits into three major palaeoenvironmental units. The data are summarized in her table 26, reproduced here as Table 22 with minor amendments to the radiocarbon dates and omitting the 'cultural units'. Microfauna from the 1976 excavation were not studied by Avery and the dates from the upper sub-units of layer 1 are thus strictly not applicable, so have been omitted from Table 22.

TABLE 22
Palaeoenvironmental interpretation of BNK 1 sequence, based on analysis of micromammalian fauna (after D. M. Avery 1979, table 26).

Dates B.P.	Layer	Vegetation	Climate	General
1 880±50 to 3 220±45 3 400±55	1 (lower) 2	UNIT 1 intermediate; as unit 3 but more scrub and less restioid vegetation on hills	warmer	mildest mild
3 900±60	5 6 7 8	UNIT 2 extensive (more open ?) grass on flats; rather less restioid/'grassy' vegetation on hills and more scrub; less dense vegeta- tion near river and on lower slopes. (relatively dry ?)		moderate
6 370±90	9 (upper)	————— changing —————		harsh
6 100±140 6 540±55	9 (lower) 10 11			UNIT 3
7 750±90	12 13	extensive dense vegetation near river and on lower hill slopes; extensive (more closed ?) grass on flats with pans and some low scrub; restioid/'grassy' (and proteoid ?) element on hillsides (peak restioid element in layer 13) (relatively wet ?)	general increase in temperature	mild mildest
9 760±85	14 15 16 17			rather harsher moderate
12 730±185	19			cooler

Perhaps the most immediately important aspect of Avery's study has been her recognition of a relatively marked change in the vegetation, from that of Unit 3 to that of Unit 2, at around 6 500 B.P. As the analyses of the artefactual and other non-artefactual components of the deposit indicate, it is at about this time that the continuum of change appears to undergo a marked fluctuation. That the division into lower and upper layer groups at layer 9 is somewhat arbitrary has been stressed elsewhere in this report. The division is nowhere precise and it is probably closer to the truth to suggest that the period during the deposition of layers 14-9, from about 9 800-6 100 B.P., was one of greater flux in the ecology of the human occupants of the cave than the preceding or succeeding periods, possibly because of greater environmental change. It is to be expected that the suggested changes in the environment were not all simultaneous and instantaneous and that their impact would therefore be reflected in different ways and at different times in the cave deposits.

The changes in the composition of the micromammalian fauna in Avery's sample that led her to separate layers 2 and 1 into a discrete vegetation unit covering the period from about 3 400 B.P. until the final occupation of the cave, are apparently not reflected in the artefactual and other faunal material. Such changes as there are appear to take place in layers 4 and 3 and are of a lesser nature than those in layers 14-9.

The suggestion, queried by Avery herself, that the grassland of Unit 3 was more closed than that of Unit 2, contrasts with the evidence of the larger mammals (Table 15). It is in the lower layers that *Hippotragus* sp. and *Connochaetes/Alcelaphus* are more common; *Damaliscus dorcas* is not present in the deposits after layer 11 and *Equus* cf. *quagga* after layer 9. These animals may be characterized as gregarious grazers with a preference for open or lightly wooded grassland, an environment that differs from Avery's suggestion of 'extensive (? more closed) grassland on the flats'. There is, of course, the problem of habitats: those of the grazers need not have been the same as those of the micromammals that formed the prey of the raptorial birds and thus found their way into the deposit—some of them, at least. It has been suggested elsewhere in this report that the coastal plain between BNK and the sea was possibly never an area of grasslands owing to the unsuitability of the soil and that a more likely locality for extensive grasslands would have been on the shale soils to the east and north-east of the site. G. A. McLachlan (1980 pers. comm.) has advised that most owls are intensely territorial and are not likely to range over a radius of more than a couple of kilometres in search of their prey. This would bring them to the edge of the shale areas. It must be borne in mind, however, that the BNK area is a mosaic of contrasting environments that provide habitats for a varying range of plants and animals, and the habitats of micromammals are relatively small.

Avery's general climatic inferences for unit 3, indicating relatively moderate to the mildest climatic conditions, except for the layer 13 period, may provide support for the previously mentioned suggestion that the relative paucity of artefacts in the lower layers may point to less intensive occupation of the cave during the earlier periods of its use by humans consequent on a milder climate being more conducive to life in the open. Against this must be placed Avery's tentative suggestion that it might have been relatively wet during this period while during the period of Unit 2, when the cave appears to have been most intensively occupied, Avery has suggested that it might have been relatively dry. It would seem, however, that warmer and wetter conditions in the Unit 3 period would have been more favourable for the development of forests than of grasslands.

A point that cannot be overlooked is that two different selective agencies contributed to the depositional process, man and the raptorial birds, the predatory behaviour of each of which would sample different aspects of the same ecosystem. This may to some extent explain some of the differences of observation and interpretation.

PLANT REMAINS

A large quantity of plant remains was recovered from the deposits but for want of a competent analyst most of it remains unsorted. The bulk of the material is carbonized wood, which might be useful for deriving inferences about environmental change, as has been done with material from Boomplaas

(H. J. Deacon 1979: 252–3). Other material such as seeds and corm cases of geophytes could provide information about the vegetable component of the diet of the prehistoric human inhabitants of the cave.

A certain amount of plant material remained with the non-organic and other organic material after this had been washed. It has been analysed by L. Horwitz and is listed in Table 23. Quantification has not been attempted since the sample analysed is only a small portion of the total.

A problem in the analysis of plant remains from archaeological deposits is to ascertain what proportion of the total was brought to the site by its human occupants. The presence of three solution cavities or 'chimneys' in the roof of the cave has undoubtedly been a contributory factor, and others are wind, birds, bats, and a variety of quadrupeds as well as man.

Proteaceae grow above the cave and *Sideroxylon inerme* in front of it and these might have been introduced by wind action although the woody parts could have been used for firewood. The seeds of the exotic *Acacia cyclops* found in layer 1 are probably the contribution of birds or rodents since this plant is not yet found in the immediate vicinity of the cave or above it, although it grows on the lower slopes of the hill and there are extensive stands of it in the river valley and on the coastal plain (cf. Figs 2, 4).

Restio spp. and *Willdenovia argentea* are also components of the fynbos above the cave and natural agencies could also account for their presence in the deposits. Some of the *Restio* stalks are charred and they might have been brought into the cave for fire-making or for bedding.

Three species of *Diospyros* are indigenous to the area, *D. dichrophylla*, *D. glabra* and *D. whyteana* (Coates Palgrave 1977: 745–746, 753–754). The fruit of *D. dichrophylla* is said to be poisonous: a common name is 'poison-peach'. No information is given regarding the fruit of *D. glabra* (cf. Smith 1966: 116) and despite one of the common names of *D. whyteana* being 'Hottentot's cherry' (Smith 1966: 252) information regarding the edibility of this fruit is not given. *Euclea racemosa* is apparently the only species of *Euclea* indigenous to the area (Jordaan 1946: 52, Coates Palgrave 1977: 739) but again there is no mention as to the edibility of the fruit. Members of the genus *Euclea* are commonly known as 'guarri' or 'ghwarrie' and the most widespread species, *E. undulata*, has edible fruits. Extracts of the bark, leaves and roots of this and other species are used for medicinal purposes (Watt & Breyer-Brandwijk 1962: 391, Smith 1966: 238–9, Coates Palgrave 1977: 741) but according to Coates Palgrave the distribution of *E. undulata* does not extend west of the Breede River area, at the eastern end of the Agulhas region (Fig. 1). The question of the introduction of the fruits of the Ebenaceae thus remains unanswered.

The fruit of *Sideroxylon inerme* are said to be edible (Smith 1966: 336) but their abundance on the trees in the BNK area and in the Cape Peninsula suggests that either this fact is not well known or that the taste is not suited to modern palates. The presence of the trees at the mouth of the cave could be a contributory factor to the presence of the seeds in the deposit without requiring the aid of man.

TABLE 23
Plant remains represented in the deposits.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ALGAE																			
ALARIACEAE																			
<i>Ecklonia maxima</i>	×																		
SPERMATOPHYTA																			
POTAMOGETONACEAE				×	×	×									×				
<i>Zostera capensis</i>																			
RESTIONACEAE				×				×											
<i>Restio</i> sp(p).			×	×	×			×				×							
<i>Willdenovia argentea</i>																			
IRIDACEAE																			
Gen. et sp. indet.	×				×	×						×							
<i>Hexaglottis longifolia</i>					×														
<i>Moraea</i> sp.													×						
MYRICACEAE																			
<i>Myrica cordifolia</i>			×																
PROTEACEAE																			
<i>Leucadendron</i> sp(p).				×															
<i>Leucospermum</i> sp(p).			×																
<i>Protea</i> sp(p).			×																
SANTALACEAE																			
<i>Colpoen compressum</i>			×		×		×												
FABACEAE (= LEGUMINOSAE)																			
<i>Acacia cyclops</i> (exotic)																			
POLYGALACEAE																			
<i>Nylandia spinosa</i>			×			×	×	×				×		×			×		
ANACARDIACEAE																			
<i>Rhus glauca</i>			×																
SAPOTACEAE																			
<i>Sideroxylon inerme</i>			×	×	×	×	×	×	×	×		×		×			×		
EBENACEAE																			
<i>Diospyros</i> sp.			×									×		×			×		
<i>Euclea</i> cf. <i>racemosa</i>			×	×	×			×				×		×		×			
CUCURBITACEAE																			
<i>Citrullus</i> cf. <i>lanatus</i>															×				
ASTERACEAE (= COMPOSITAE)																			
<i>Chrysanthemoides monilifera</i>			×	×	×			×	×				×	×					×

Note. X indicates presence in a layer.

There can be no question, however, that the presence of *Ecklonia maxima* and *Zostera capensis* is the result of human agency, but their function is problematic. There are, as far as is known, no early ethnographic records of the use of kelp (*E. maxima*) by the Khoisan for either food or medicinal purposes. Budack (1977: 37) reports, however, on the modern use by the Topnaar Hottentots of South West Africa of powdered *E. maxima* and *Laminaria schinzii* on wounds, noting that both are rich in iodine. In the entry for 6 March 1654 in the Journal of Jan van Riebeeck there is a reference to the use by the Hottentots of 'trombas' for the storage of train-oil rendered from the blubber of a dead whale (Moodie 1838: 46, Van Riebeeck 1651-5: 205, Thom *ed.* 1952: 218). 'Trombas' (trumpets) is the old Portuguese name for *E. maxima*. The long, hollow and distally swollen stipe could also have been used for carrying water, and a modern use as a 'pressure-cooker' for cooking *Halotis midae* in the coals of a barbecue pit (A. E. Louw 1980 pers. comm.) could possibly represent the continuation into modern times of a tradition derived from the Khoisan. C. E. Labuschagne (1980 pers. comm.) has advised that the sliced stipes of *E. maxima* make a palatable if glutinous foodstuff when boiled and can be used as a thickener for stews. Such a use would require a cooking vessel, but it cannot be assumed that the recovery of remains of *E. maxima* only from layer 1 is related to the introduction of pottery into the area as preservation factors may also be involved. In the collection from Rooiels Cave near Cape Hangklip which was excavated in 1921-2 by A. D. Divine (South African Museum collection AA4029-80) is a knotted piece of kelp stipe. Although intrinsically interesting this artefact throws little light on the possible uses of this marine plant.

The estuarine grass *Zostera capensis* is present in small quantities, and probably in more of the layers than indicated in Table 23. It occurs in shreds or small wads not more than about $5 \times 5 \times 0,5$ cm greatest dimension and never in quantities sufficient to indicate its having been used as a bedding material. Such a use was suggested by the presence of apparently larger quantities at Oakhurst, Glentyre and Matjes River (Sampson 1974: 308; cf. Goodwin 1938: 236, 238 *re* Oakhurst). There are no known records, early or modern, of the use of this plant for food or medicine and its presence in the BNK 1 deposits in such small quantities cannot be satisfactorily explained.

The waxberry *Myrica cordifolia* is a shrub of the coastal dunes rather than of the coastal plain. Its wax-covered berries are eaten by starlings (Sturnidae—P. Fairall 1980 pers. comm.) which nest in and near BNK 1 and could therefore be considered as possible contributors of the seeds. Thunberg (1795: 167), observing that the wax was removed by boiling the berries, commented that 'the farmers use it for candles, but the Hottentots eat it like a piece of bread, either with or without meat'. The berries contain, *inter alia*, an unsaturated oil (Watt & Breyer-Brandwijk 1962: 785) and the fruit may thus have had a dietary value beyond that of just the wax. Coates Palgrave (1977: 95) mentions that the 'wax' coating of *M. serrata* is, in fact, not a wax but a true fat rich in unsaturates; and the same may be true of *M. cordifolia*.

All the other plants listed in Table 23 that have not already been discussed have edible fruits or, in the case of the Iridaceae, corms. It seems probable that the Iridaceae were brought to the site by primates, baboons if not man. Not all species of *Moraea* are edible (Watt & Breyer-Brandwijk 1962: 505 ff., Smith 1966: 470) but it may be assumed that the species present in the BNK 1 sample are edible as there is no record of the toxic substances in the inedible species having been used as a poison by the Khoisan. A limited survey of the area in the vicinity of the cave showed that Iridaceae are common but not abundant on the Table Mountain Sandstone hill slopes adjacent to BNK. Three genera could be identified in the field: *Chasmanthe* (cf. *aethiopica*: Maytham Kidd 1973: 19.5), *Gladiolus* (cf. *alatus*: Maytham Kidd 1973: 59.1), and *Aristaea* (cf. *macrocarpa*: Maytham Kidd 1973: 79.2). *Melaspheerula ramosa* (Maytham Kidd 1973: 62.7) grows on rocky outcrops in the shade of the trees in front of the cave.

All the berry-bearing plants listed in Table 23 are to be found in the vicinity of the cave and there are others with hard seeds, such as *Carissa bispinosa* and *Olea capensis* that grow near the cave but have not been identified in the samples. *Rhus glauca*, of which only leaves are present in layer 1, has edible drupes (Smith 1966: 308). Smith also records that several species of *Rhus* (korentebos) have 'strong resilient branches which were formerly used by Bushmen and Hottentots for making their bows'.

An unusual feature was the recovery from layer 15 of sixteen well-preserved seed skins of a member of the family Cucurbitaceae. As indicated in Figure 43, these all show marks of having been gnawed. T. Arnold (*in litt.* 7 November 1980) has advised that the seed skins have been identified as being from a species of *Citrullus*, all the modern cultivars of which are presently referred to *C. lanatus*. Arnold is of the opinion that the skins cannot be contemporary with the deposit in layer 15 and points out that microscopic examination of the skins indicates that they have been gnawed by a rodent to

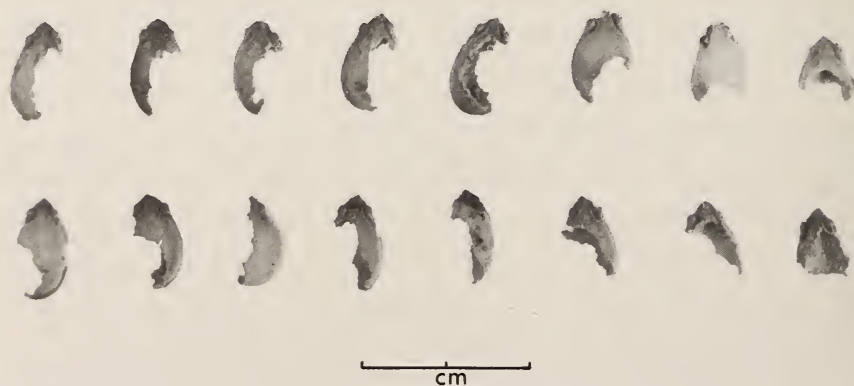


Fig. 43. Cucurbit (*Citrullus* sp.) seed skins from layer 15 showing evidence of having been gnawed by rodents.

obtain the endosperm. It would seem advisable in the circumstances to regard these seed skins as intrusive into layer 15.

Although the plant remains represented in Table 23 may be considered a random sample in that they represent non-deliberate remnants in the excavated material after it had been washed, because the sample is small in relation to the total amount of plant remains present in the deposit, it is not appropriate here to attempt to derive any environmental or human ecological inferences from the remains studied, save on a very general level.

Coates Palgrave (1977: 722) describes *Sideroxylon inerme* as 'almost always a tree of coastal woodland and littoral forest' and evidence of its presence from at least layer 17 up suggests that there has been no major environmental change in the last 10 000 years or so that has affected the tree's viability in the area.

One of the common names for *Nylandtia* (*Mundia*) *spinosa* is 'duinebessie' (dune berry: Smith 1966: 205) and the presence of the seeds of this plant, also from layer 17 up, attests to the relatively unchanged sandy nature of the coastal plain. It should be mentioned, however, that while *N. spinosa* is abundant on the coastal plain and in the river valley, it generally grows there as a small shrub up to 1 m in height, while on the limestone ridge of BNK, where it forms a not insignificant part of the fynbos, it grows to a height of over 2 m.

Euclea racemosa is another plant of the coastal zone, found as a shrub in the sandy soil but growing to tree height (6 m) in coastal forests (Jordaan 1946: 52, Coates Palgrave 1977: 739).

Chrysanthemoides monilifera is adapted to a wide range of habitats, from coastal dunes to rocky hillsides and the verges of evergreen forests (Coates Palgrave 1977: 913) and therefore cannot be used as a sensitive environmental indicator.

In the Cape Peninsula *Myrica cordifolia* flowers in the winter (April–July), *Nylandtia spinosa* in the winter and spring (April–October), *Rhus glauca* is spring-flowering (August–September), *Chrysanthemoides monilifera* flowers throughout the year but mainly from spring to early winter (October–May), and *Colpoos compressum* from summer to winter (December–June) (Maytham Kidd 1973). Even allowing for localized variation in the flowering and thus fruiting season, the presence of the seeds of these plants offers no clear indication of the season(s) during which the cave was occupied, even if it is assumed that all the seeds were brought into the cave by its human occupants. A more precise, quantitative analysis may, however, reveal that there were changes in the seasons during which the cave was occupied in different times during its occupation history.

Iridaceae are generally spring to summer flowering and their corms may be assumed to reach their maximum growth during the period of the winter rains and before flowering commences. In the BNK area, as has been mentioned, Iridaceae are common but not abundant. Moreover, the corms of these plants seem mostly to be small and firmly wedged into crevices in the rock. It was

found almost impossible to remove these intact, even using a metal screw-driver. This suggests that a thicker and more easily broken implement such as a wooden digging stick would have been ineffectual, although the presence of corm cases in the BNK 1 deposits testifies to a certain success in collecting them. However, the lack of abundance of these geophytes as well as the difficulty of getting them out of the ground suggests that they might not have been an important part of the diet of the human occupants of BNK 1, or not to the extent that has been suggested for the occupants of Melkhoutboom (H. J. Deacon 1976: 162, 174).

Although *Olea africana* or *O. capensis* have not been identified in the BNK 1 sample, a phenomenon observed during the 1980 field season at BNK 3 during the first two weeks of July is worth recording. On the Die Kelders coast, which faces north, low shrubs of *O. capensis* 1,0–1,5 m in height were found to be heavily laden with ripe fruit, especially where the shrubs were protected from the seasonally prevailing north-west wind. At BNK, however, where *O. capensis* grows into sturdy trees 3 m or more in height, most of the trees had not even begun to come into flower and only one small shrub was found, near the top of the hill, that had a few ripening fruit.

While the Die Kelders coast receives full exposure to the available sunshine, at this time of year (mid-winter) the southerly aspect of BNK receives only an hour or two a day, in the early morning or late afternoon, and this is undoubtedly the reason for the differences in the seasonal development of this species in the two areas. In view of the edibility of this fruit (Coates Palgrave 1977: 759), and assuming that it is not a recent immigrant into the area, it is somewhat surprising that its seeds were not found in the deposits at Die Kelders. There was a conspicuous absence of plant remains from the Die Kelders deposits (Schweitzer 1979: 206–7), and the presence of seeds of *O. capensis*, evidently available during the winter, would have provided supportive evidence for the hypothesis that the site was occupied during the winter months (Schweitzer 1979: 219). On the other hand, the presence of seeds of *O. capensis* in the BNK 1 deposits, should they be identified when the bulk of the plant remains are analysed, need not indicate spring–summer occupation to coincide with the ripening of the fruit in the vicinity of the cave as the fruit could have been collected from the Walker Bay coast during the winter as well as from BNK later in the year.

In an early account of the Hottentots of the Cape, Grevenbroek (1695: 185) recorded that it was the work of the men to prepare the winter's supply of plant food. Grevenbroek mentions 'wild almonds' (*Brabeium stellatifolium* (growing in the Bredasdorp district according to Coates Palgrave (1977: 123) but not observed in the BNK area)), the 'larger arum' (probably the rhizome of *Zantedeschia aethiopica*, growing in the Uilkraals River valley) and 'various bulbs' (probably including Iridaceae). These were exposed to the sun, roasted on a small fire and then stored 'in ditches and caves'. This observation carries several interesting implications regarding seasonality, espe-

cially with regard to the occupation of caves, but has no direct relevance to BNK 1 since, apart from the corm cases of 'various small bulbs', no other indications were found of the preparations described by Grevenbroek, nor were any storage pits found at the site such as those discovered at Boomplaas (H. J. Deacon *et al.* 1978: 55). It seems likely, however, that most of the edible fruits whose remains are recorded from the BNK 1 deposits would have been eaten at the time they were collected since most, if not all, would not have been amenable to any process of preservation or storage.

SUMMARY

Mammals, excluding *Homo sapiens* and micromammals, were divided into six size classes based on their live mass. Perhaps the most significant changes to be observed are in the large medium and very small size classes. The large medium size class, which consists mostly of bovids, shows a gradually increasing trend from layer 19 to layer 13, in which the frequency reaches almost 46 per cent of the layer total. From layer 12 up frequencies decline, accounting for less than 10 per cent of the layer total in layer 9, and in layers 8–1 the frequency exceeds 5 per cent only in layers 3 and 2.

The very small size class, in which there are no bovids, shows a generally declining trend in layers 17–10, after which frequencies increase, reaching a peak of 53,5 per cent of the layer 4 total. In layers 8–1 the frequency falls below 40 per cent of the layer total only in layers 7 and 3, whereas in layers 19–9 it reaches this frequency only in layer 17.

It is, however, only in layers 15 and 13 that the three larger size classes account for more than 50 per cent of the layer total, and in layers 6–1 the three smaller size classes account for over 80 per cent of layer totals.

There is one main period only, that from layer 14 to layer 9, in which bovids are numerically more common than all other animals. Because there has been no separation of the sub-units of layer 1 and because this layer includes a basal sub-unit in which there are no sheep remains, it has not been possible to determine the effect of the introduction into the area of domestic animals on the economy of the cave occupants beyond observing that layer 1 has the highest frequency of small medium animals of all the layers, and that almost two-thirds of these are *Ovis aries*.

Shellfish frequencies are generally very low in layers 19–10 and account for only 1,3 per cent of the site total. Relative frequencies (ADs) show a generally increasing trend from layer 12, however, up to layer 2 with a slight decline in layer 1. Layer 3 has an anomalously high frequency, with an AD a hundred times that of layer 12, more than ten times that of layer 9, and three to four times those of layers 6–4 and 2–1.

In layers 16–11 *Donax serra* is the most commonly represented species but *Turbo sarmaticus* is always the most common species in the upper layers in terms of flesh mass, although it declines numerically in layers 6–3, in which *Oxysteles sinensis* becomes more common.

An analysis of the lengths of five species of *Patella* and comparison of four of these with data for modern populations shows that it was generally the larger-sized individuals that were being collected, except in the case of *P. cochlear*, which was collected mainly in the middle of its population size range. It was concluded that despite evidence for changes in the mean lengths of some species in successive layers, the periods of time involved, compared to the longevity of the species, do not allow any conclusions to be reached regarding the effect of human predation on the shellfish populations; nor was it considered possible to extrapolate inferences regarding changes in mean sea temperature.

Fish are sparsely represented in the lower layers, with some 95 per cent of the site total in layers 9–1. The ADs indicate a gradually increasing trend in layers 9–5 and a decline thereafter.

Reptiles are represented by two species each of tortoise, snake and lizard. Layer 14 contained what may be termed a 'tortoise midden' but the ADs reveal no clear trends of increase or decrease, suggesting that the collection of these animals was not in any way affected by the changes in the representation of the mammal size classes. Remains of snake are present only from layer 13 up (in the sample from the 1974 excavation) and while this may have some human ecological significance, frequencies are too low to allow more than the suggestion of such a possibility.

Micromammals from the deposit were analysed by D. M. Avery (1979), who has used the data derived to suggest palaeoenvironmental changes throughout the period of the occupation of the cave, with three major vegetation units represented, those of layers 19–10, 9–3, and 2–1. Avery's interpretations contrast to some extent with those that can be derived from the analysis of the artefacts and the other fauna, but this may simply be a reflection of the fact that two very different types of predator are involved.

Plant remains have for the most part not been examined. The small sample that has been studied shows it to consist of species present in the area today but does not allow the deriving of environmental or human ecological inferences.

In general, the faunal evidence indicates a change in exploitation patterns that began about 7 500 years ago. Although there is evidence of exploitation of marine resources from the initial occupation of the cave, this only became marked from about 6 000 B.P. and represents a substantial addition to the diet of the cave occupants at a time when the pattern of procurement of land game indicates a decrease in the amount of flesh being brought back to the cave. This suggests a change in the ecology of the human occupants of BNK 1, but whether the cause was demographic, cultural, or environmental, or a combination of these, is not directly deducible from the site data alone.

BNK 1 IN RELATION TO OTHER SITES

The artefactual and faunal samples from BNK 1 provide a useful body of information that may be compared with data from sites of comparable age in the adjacent regions of the Cape. In this way the BNK 1 sequence can be

'placed' in the industrial sequence already established for the area, and a contribution made towards the assessment of variability within the Late Stone Age.

Of particular importance is Nelson Bay Cave, since the material from this site has provided the basis for the first comprehensive description, and consequently definition, of the artefactual components of the 'pre-Wilton' industries that have been termed 'Albany' and 'Robberg' at Nelson Bay Cave (Klein 1974, J. Deacon 1978), and Melkhoutboom (H. J. Deacon 1976).

Problems in the comparisons arise from the fact that sites such as Die Kelders and Wilton contain only part of the post-Pleistocene sequence while others, such as Nelson Bay Cave, Melkhoutboom, Elands Bay Cave and probably also Wilton, have sequences that are interrupted by periods of non-occupation. The Nelson Bay Cave sequence studied by J. Deacon (1978) also lacks the final occupation sequence, from about 5 000 B.P., excavated by R. R. Inskeep and yet to be published. In some cases, too, the series of radiocarbon dates, for BNK 1 as well as other sites, are insufficient to allow precise correlation of stratigraphic units and their contents. Comparisons are also limited by differences in data presentation or because comprehensive site reports have yet to be published.

For convenience, artefactual and faunal categories and classes are discussed in the same order as in the analysis of the BNK 1 material. These divisions are, of course, somewhat arbitrary and the overall character of the assemblages is also important.

STONE ARTEFACTS

Raw materials

In the BNK 1 stone artefact sample certain trends in raw material frequencies may be observed that allow the layers to be grouped on this basis (Fig. 7, Table 26). The trends, in which quartz, quartzite and silcrete are variously the predominant raw material, are chiefly influenced by the unmodified artefact category and even within this category there are differences in the predominance of the raw materials for classes such as unmodified flakes (Table 26). Silcrete is the most common raw material in the utilized and retouched artefact categories, except in a few cases in the lower layers in which artefacts in these categories occur only in low or minimal frequencies. Although the overall character of the artefact sample is useful for comparative purposes, the bias introduced by classes such as chips and chunks, which will have had little or no potential for use, suggests that it is probably more profitable to compare raw material frequencies in specific categories, e.g. utilized-modified and retouched, or classes, e.g. unmodified flakes and blades, cores and the two categories of artefacts that can be shown to have been used.

BNK 1 layer 19, and possibly also layer 18, falls within the time range of Nelson Bay Cave layer BSL, the uppermost of the three 'Robberg' layers, layers YSL and YGL being in the time range of 16 000–18 000 B.P. (Klein

1972a: 202; J. Deacon 1978: 89–90, fig. 3). In the BNK 1 layers quartz is the predominant raw material, as it is in Nelson Bay Cave layers YGL and YSL, while quartzite is predominant in BSL and in all the overlying layers (J. Deacon 1978, table 2). There is an increase in the frequency of quartz in the 'Wilton' layers but this does not reach the frequencies of the 'Robberg' layers. Frequencies of silcrete are low in all layers although in layer YSL it is marginally (1,1%) more common than quartzite. Quartzite predominates only in BNK 1 layers 17–15, while silcrete is most common in layers 9, 8, 6, and 5, and quartz predominates in all the other layers.

In the retouched artefact category silcrete is absent from all the 'Albany' layers at Nelson Bay Cave and does not reach 25 per cent of the category total in any of the other layers. Quartzite is generally the most common raw material in the 'Albany' layers (the two artefacts in layer GSL are of quartzite and chalcedony) and quartz or chalcedony in the 'Wilton'.

The 'Robberg' industry of the Basal Unit at Melkhoutboom is probably at least 1 000 years older than BNK 1 layer 19, and is separated from the 'Albany' deposits by a hiatus covering the period 14 000–10 500 B.P. (H. J. Deacon 1976, table 3). Deacon (tables 8–9, 12) provides raw material frequencies for specific classes only. Combination of the data in his tables 8 and 9, for chips, chunks and unmodified flakes, indicates that quartzite is the most common raw material except in the lower 'Wilton' units WBM and M in which chalcedony predominates, and in the uppermost 'Wilton' unit OMB in which silcrete predominates. Quartzite is the most common raw material for unmodified flakes in all the layers except OMB in which silcrete is most common. For the four classes of retouched artefacts in Deacon's table 12 chalcedony is the most common raw material in the four lower 'Wilton' units WBM–MB, and silcrete in the two upper, CAF and OMB. There were apparently no 'formal tools' in the 'Albany' and 'Robberg' deposits (H. J. Deacon 1976, tables 10–12).

The Wilton Large Rock Shelter has yielded dates obtained from charcoal in layers 2B and 3F that show these deposits to span the period from about 2 270–4 860 B.P. A third date of about 8 620 B.P. was obtained from bone from a human burial excavated by Hewitt in 1921 and considered by J. Deacon (1972: 14) to relate to the base of layer 3. This date is problematic when related to the stratigraphy (J. Deacon 1972, fig. 3) and suggests a hiatus in the deposition, by inference between layers 3F and 3J, but more probably between 3J and 4A. Thus, while it is possible to relate the Wilton deposits down to layer 3F to those from about the middle of BNK 1 layer 1 to somewhere between layers 5 and 9, the Wilton layers below 3F cannot be satisfactorily correlated with the BNK 1 sequence, although H. J. Deacon (1976, table 3) has assigned layers 3G–3I to the 'Formative Wilton', dated to about 6 000–8 000 B.P. and layers 4A and 4B to the 'Albany', dated to about 8 000–11 000 B.P.

J. Deacon (1972, figs 4–5) provides frequency diagrams for raw materials in selected artefact classes only. The indications are, however, that in the 'waste' classes there were higher frequencies of quartzite and quartz than other

raw materials in layers 4B and 4A. Silcrete appears to have been increasingly used throughout the rest of the sequence, as well as being the most commonly used raw material for retouched artefacts, although more scrapers in layers 4B–3H were chalcedony than silcrete.

The raw material frequencies for unmodified flakes from Buffelskloof (Opperman 1978, table 4b) show quartz to have been the most common raw material for this class throughout the whole sequence. Chalcedony ranks second in the upper part of the sequence, layers BOL1–CH2, quartzite in the middle, layers CH3–ZJ2, and 'other' (predominantly hornfels) at the bottom, layers ZJ3–HE2. Quartz and chalcedony are generally the raw materials most commonly used for retouched artefacts (Opperman 1978, fig. 6). The Buffelskloof sequence covers much the same period of time as BNK 1 layers 19–5, although layer HE2 has a basal date in excess of 22 000 B.P. (Opperman 1978: 21).

Unmodified artefacts

Flakes from BNK 1 account for 21,2 per cent of the unmodified artefact category (Table 4), while in the Nelson Bay Cave sample (J. Deacon 1978, table 1) frequencies range from about 86 per cent in the 'Robberg' to almost 92 per cent in the 'Wilton'. A partial explanation of the difference is that Deacon (1978: 91) has included the class of chips in the untrimmed flake class. However, even if chips are added to the unmodified flakes in the BNK 1 sample they still account for only 76,1 per cent of the unmodified artefact category total, well below the total for any of the Nelson Bay Cave industrial units. A possible reason for these differences is the high frequency of quartzite at Nelson Bay Cave, a material that is predominant at BNK 1 in layers 17–15 only.

Blades, in recent analyses of stone artefacts (e.g. J. Deacon 1972, 1978; H. J. Deacon 1976; H. J. Deacon *et al.* 1978; Opperman 1978), have not been separated from flakes in the unmodified artefact category, so that it is not possible to determine whether the BNK 1 distribution is similar to that at other sites. This is unfortunate since one of the characteristics of the 'Robberg industry' is a high frequency of quartz micro-blade cores and it would have been useful to have been able to compare core:blade ratios, especially in samples from the 'Robberg'.

Cores in the Nelson Bay Cave sample (J. Deacon 1978, table 1) were more common in the 'Albany' layers than in the 'Robberg' or 'Wilton' and bladelet cores more common in the 'Robberg' than in other layers (Deacon's term 'bladelet' equates the use in this report of 'micro-blade'). The first instance is unlike the situation at BNK 1, where 63,2 per cent of the cores came from layers 1–9, but the second is similar, allowing that Nelson Bay Cave layer BSL and BNK 1 layer 19 are approximately of the same age. Blade cores were recovered only from the upper part of the Buffelskloof sequence (Opperman 1978, table 3).

Utilized and modified artefacts

Utilized flakes in the Nelson Bay Cave sample (J. Deacon 1978, table 1) include notched flakes, which are included in the retouched artefact category in the BNK 1 analysis. Even when notched flakes are excluded, there are more than twice as many utilized flakes in the Nelson Bay Cave sample than in that from BNK 1. Using totals that exclude notched flakes, utilized flakes account for 58,6 per cent of the utilized artefact category and are relatively most common in the 'Robberg', the percentage frequency decreasing by about 10 per cent in the 'Albany' and again in the 'Wilton'. In the BNK 1 sample, utilized flakes account for only 42,8 per cent of the utilized and modified artefact category and are relatively more common in layers 17-13 (57,4% of the category total) than in layers 19-18 (29,7%) or layers 9-1 (48,8%, or 54,4% in layers 9-7, which may be the layers chronologically comparable with that part of the Nelson Bay Cave 'Wilton' studied by Deacon).

In the Melkhoutboom sample (H. J. Deacon 1976, table 9) 'retouched flakes' are most common in the W and M units of the 'Wilton', numerically as well as on an AD basis.

'Trimmed flakes' were included in the 'waste' category in the Wilton inventory (J. Deacon 1972, table 1). The total of these, 1 367, is considerably higher than the BNK 1 total of 592 utilized flakes. The highest frequencies are in Wilton layers 3B-3G and 4A and in BNK 1 layers 9-5 (except layer 7), so that the situation at both sites is broadly similar.

Opperman (1978, table 2) has also included 'trimmed flakes' in the 'waste' category in the Buffelskloof inventory. Frequencies are generally low throughout the sequence and even the highest frequencies, in layers BOL2 and CH3, seem merely to reflect the fact that these layers have the highest frequencies of stone artefacts. Layer BOL2 is younger than BNK 1 layer 9, and layer CH3 younger than layer 12.

Utilized blades have not been listed separately in the inventories for any of the sites used for the inter-site comparisons. It may be that, as in the case with the BNK 1 sample, they are relatively few.

Scaled pieces in the Nelson Bay Cave inventory (J. Deacon 1978, table 1) occur in very low frequencies in layers BSL-RA, and 83 of the site total of 97 were recovered from the uppermost 'Wilton' layers BSC and IC. There is thus a general similarity in the distribution of these artefacts at Nelson Bay Cave and BNK 1, although layer 18 has a higher frequency (percentage as well as actual) than layer BSL.

These artefacts are also uncommon in the Melkhoutboom stone artefact sample (H. J. Deacon 1976, table 7). There were none in the 'Robberg' and 'Albany' deposits, and the highest frequency came from the W unit, which is about the same age as BNK 1 layer 9.

In the Wilton inventory (J. Deacon 1972, table 1) *pièces esquillées* were included with 'other tools', there being no category of utilized artefacts. They are not common in any of the layers and the highest frequencies (12 and 13)

were in layers 3D and 3E, which may be somewhat older than BNK 1 layers 7–5, in which the latter site's highest frequencies occurred.

There were apparently no scaled pieces found at Buffelskloof (Opperman 1978, table 2).

Grindstones are surprisingly rare in the BNK 1 stone assemblage and the three that were recovered are classified as combination hammerstones–upper grindstones (Table 6). Die Kelders yielded 87 (Schweitzer 1979, table 17) and Nelson Bay Cave 44 (J. Deacon 1978, table 1), although these sites have smaller total stone artefact samples than BNK 1. Low frequencies of grindstones are also recorded from Wilton (J. Deacon 1972, table 1) and Melkhoutboom (H. J. Deacon 1976, table 13), and none at all appear to have been found at Buffelskloof (Opperman 1978, table 2).

In a study of sites in the Clanwilliam district, Mazel (1978, Appendix 3) records variable but usually low or nil frequencies in the western Cape sandveld or coastal plain, one exception being the Verlore site, which is closest to the coast of all the sites studied by Mazel. BNK 1 is, however, almost as close to the coast as Verlore, and the recovery of 17 upper grindstones ('rubbers') from the late Holocene DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2) tends to discount the suggestion that the use of these artefacts might have been more common at sites at or near the coast.

Bored stones, even in the fragmentary form in which they were found in the BNK 1 deposits, by their presence in a site on the edge of the coastal plain are not consistent with the suggestion by Mazel (1978: 79) that such artefacts are not to be found on the coastal plain because weighted digging sticks are unimportant away from the mountains. What seems more likely, especially where surface exposures are concerned, is that these artefacts have proved attractive to casual collectors. Reference to the monograph by Goodwin (1947) on the bored stones of South Africa will reveal that these artefacts are not—or have not been—absent from sites at the coast or on the coastal plain.

Heavy edge-flaked pieces were sporadically distributed through the BNK 1 deposit, whereas at Nelson Bay Cave they were found in almost every level (J. Deacon 1978, table 1). At BNK 1 they account for only 0,7 per cent of the utilized and modified artefact category total, while at Die Kelders they comprise 2,7 per cent of the utilized artefact category total. At Nelson Bay Cave they account for 1,2 per cent of the total for the utilized artefact category in the 'Robberg' layers but increase to 23,3 per cent of the 'Albany' total and 24,6 per cent of the 'Wilton' total. Whatever their function, heavy edge-flaked pieces were clearly a more important component of the Nelson Bay Cave artefact assemblage than of those of BNK 1 or Die Kelders.

Retouched artefacts

Scrapers were of particular interest in the analysis of the BNK 1 stone artefact assemblage. This interest was stimulated by the evident difference of the scrapers from the middle layers from those of the upper. On the basis of the

analysis of the material from the 1974 excavation it had been assumed that layer 9 marked the beginning of the 'Wilton' tradition at the site, and it was recalled that Goodwin (1938) had stated that, underlying the 'Wilton' deposits at Oakhurst, there were deposits containing 'Smithfield' artefacts.

According to Goodwin (1938: 313, 314) these deposits contained 'vast numbers of typical Smithfield scrapers', said to have exceeded 5 000 in the 'Smithfield C' levels alone. The fate of the bulk of this large collection is unknown. A small, representative collection is retained by the Archaeology Department of the University of Cape Town but the major part of the University's holding was donated in 1961 to the South African Museum (AA6990) by R. R. Inskeep on behalf of the University.

In view of the evident differences in the size and shape of the scrapers from the layers above and below layer 9 at BNK 1 (Fig. 17) it was decided to analyse the Oakhurst 'Smithfield' scrapers in the Museum's collection to see how these compared with those from BNK 1 layers 9-13, those from layers 14-19 being considered too few to warrant inclusion.

The Oakhurst material had previously been analysed by Fagan (1960) and Schrire (1962). The differences of opinion or interpretation that exist as a result of these analyses are outside the scope of the present report except in so far as they concern the reliability of the Museum's collection as being representative of the Oakhurst scraper sample as it originally existed. The material is still stored in the bags in which it was received from the University and these bear the excavation level references but, since the artefacts themselves have not been marked, it is no longer possible to determine whether they are still correctly bagged.

Fagan (1960, table 3) worked on a 'Smithfield C' scraper sample of 720 and a 'Smithfield B' sample of 274. Schrire (1962: 181, table 1), who claimed to have had access to material not seen by Fagan, recorded a total of only 496 'Smithfield C' scrapers but 354 of 'Smithfield B'. Schrire's reportedly augmented sample was thus actually some 17 per cent smaller than Fagan's; her 'Smithfield C' sample was about 31 per cent smaller than Fagan's, while her 'Smithfield B' sample was 29 per cent larger. This raises the question of whether the material was mixed subsequent to Fagan's analysis and prior to Schrire's.

There are also problems regarding the distribution of scraper sizes in the Oakhurst samples. These may result from mixing or they may relate to different methods of measurement used by Fagan and Schrire and for the present analysis. For the present analysis, determination of the plane dimensions followed the method of J. Deacon (1972, fig. 6) used for the measuring of scrapers from Wilton. Length is the dimension along an axis taken from the centre of the retouched edge, and width the dimension along the axis at right angles to the length. Thickness is the greatest vertical distance between the dorsal and ventral surfaces of the scraper.

Fagan (1960, table 3) recorded no 'Smithfield C' scrapers less than 15 mm or more than 40 mm long and Schrire (1962, table 1) recorded no 'Smithfield B'

scrapers less than $\frac{1}{2}$ in. (approx. 13 mm) long, but in the present analysis scrapers in these length ranges were found (Fig. 44).

It was found that the scrapers from the top and bottom of Terrace 3, the 'Smithfield B' deposit, have been kept separately bagged, and as these appeared to be different in size they were treated as discrete samples. There were only 42 scrapers from the top of Terrace 3 and 24 from the bottom, and it was therefore decided that only one bag of scrapers, numbering 101, would suffice for the 'Smithfield C' sample from Terrace 2. Examination of other scrapers from this level indicated that the sample chosen was representative.

The results of the metrical analysis of the Oakhurst 'Smithfield' scrapers are presented diagrammatically in Figure 44. These indicate a continuous decrease in size from the bottom of Terrace 3 ('Smithfield B') to Terrace 2 ('Smithfield C') but no change in the mean shape (length : width ratio).

Statistical comparison of the samples from BNK 1 layers 9–13 with those from the Oakhurst 'Smithfield' was by means of the Kolmogorov–Smirnov two-tailed test (Siegel 1956: 127–136) carried out on each pair of samples and for each of the four attributes. Three of the samples, those from BNK 1 layers 11 and 13 and that from the bottom of Oakhurst Terrace 3, have frequencies below the minimum of forty specified for the test. However, application of the one-tailed test, for which no minimum is stipulated, in most cases gave the same results as the two-tailed tests. Where there were differences, these were of the order of one level of significance, in the direction of greater significant difference.

Because of the generally low frequencies in each sample, especially when these are distributed over the whole range, frequencies in each of the attribute classes were grouped. Class intervals of 5 were used for length and width and 3 for thickness and length : width ratio.

The results of the two-tailed tests are given in Table 24. It is immediately apparent that the layer 9 sample is sufficiently different from all the other samples, except that from layer 13, to warrant its exclusion from further consideration at this point. The layer 10 sample is not significantly different from the 'Smithfield C' sample, and the layer 11 sample differs significantly from the 'Smithfield B' samples only in width. The layer 12 sample is more like that from the top of the 'Smithfield B', also differing significantly only in width. The layer 13 sample is not significantly different from the 'Smithfield C' and differs from the sample from the top of the 'Smithfield B' only at a low level of significance, again in width. The difference in width is, however, very highly significant when the layer 13 sample is compared with that from the bottom of the 'Smithfield B'. In general the 'Smithfield B' scrapers are significantly wider than those from BNK 1 layers 10–13, a fact that is borne out by the Dice–Leraas diagrams in Figures 17 and 44. That the Oakhurst scrapers are predominantly made of quartz while those from BNK 1 are silcrete cannot be accepted as a satisfactory single explanation, and since the relevant deposits are believed to be approximately coeval, another explanation, possibly cultural, must be sought.

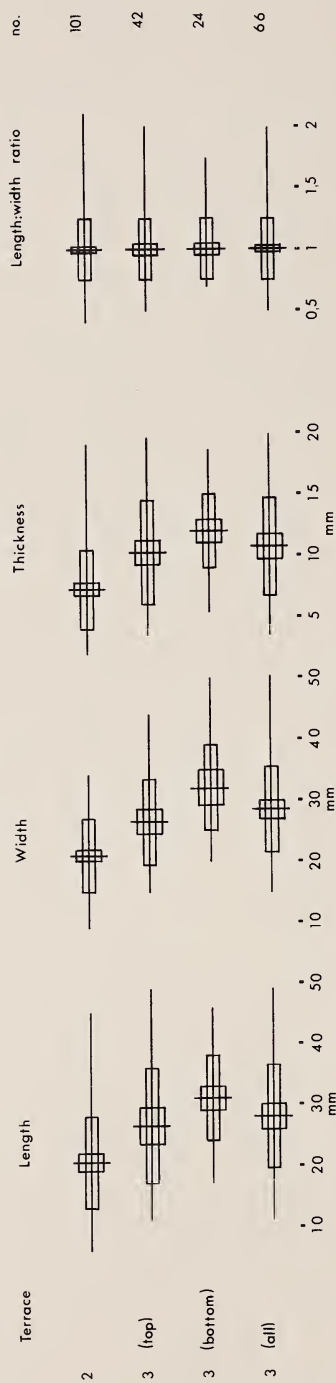


Fig. 44. Modified Dice-Leraas diagrams of dimensions and length : width ratios of scrapers from the 'Smithfield' levels at Oakhurst. Terrace 2 = 'Smithfield C', Terrace 3 = 'Smithfield B'. The data for the samples from the top and bottom of Terrace 3 are first shown individually, then combined. Numbers on the right indicate the sample size. For explanation of symbols, see Figure 8.

TABLE 24

Stone: matrix of results of Kolmogorov-Smirnov tests on paired samples of scrapers from BNK 1 and Oakhurst.

Layer																										
10	VHS VHS		HS O																							
11	VHS VHS		HS VHS		HS O		O LS																			
12	VHS VHS		VHS VHS		S O		O O		O O		O O															
13	VHS S		O O		O O		O O		O O		O O		O O													
SC	VHS LS		HS O		O O		O O		VHS VHS		O HS		LS VHS		O S		O O		O O							
SB(t)	VHS VHS		VHS O		LS O		VHS O		O O		HS LS		O O		VHS O		O LS		LS S		LS O					
SB(b)	VHS VHS		VHS O		VHS S		VHS O		O O		VHS LS		VHS O		VHS O		LS O		VHS O		VHS VHS		O O		O O	
	9		10		11		12		13		SC		SB(t)													

Note. The numbered layers are from BNK 1, those with letters are from Oakhurst. SC = 'Smithfield C' (Terrace 2); SB(t) = 'Smithfield B' (top of Terrace 3); SB(b) = 'Smithfield B' (bottom of Terrace 3).

In each block, upper left = length; upper right = width; lower left = thickness; lower right = length:width ratio.

VHS = very highly significant difference at 0,001 level; HS = highly significant difference at 0,005 level; S = significant difference at 0,01 level; LS = little significant difference at 0,05 level; O = no significant difference at 0,1 level.

It seems reasonable to assume that despite the inference that can be drawn from the comparison of the BNK 1 and Oakhurst 'Smithfield' scrapers, a 'Smithfield C' phase did not, at BNK 1 or elsewhere, precede as well as succeed a 'Smithfield B' phase, as is implied by the indication in Table 24 that the BNK 1 layer 13 scrapers are not significantly different from the Oakhurst 'Smithfield C' scrapers, nor from those in BNK 1 layers 12-10 and that layer 13 is the only layer in which the scrapers have any resemblance to those of layer 9. It would be justifiable, in fact, to regard such an inference as no more than a 'statistical artefact' resulting from the comparison of small samples on the basis of an inadequate number of attributes with too great a common range. Goodwin (1938: 318) observed that 'there is no great difference to be observed between the general types of implements to be found between this floor and those found above. The variation is one of size or, more accurately, a change in the distribution of sizes'. The 'floor' referred to is the 'carbon floor', which Goodwin (1938: 239) considered to separate the 'Smithfield C' deposit from the underlying 'Smithfield B'. This has been dated to $7\,910 \pm 70$ years B.P. (Pta-377: J. Deacon 1979: 31), which makes it somewhat older than BNK 1 layer 12 (Table 1).

Where the BNK 1 scrapers are concerned, however, a change in size tends to be accompanied by a change in shape and, as indicated in Figures 17 and 44, the scrapers from BNK 1 layers 10–13 tend to be longer than they are wide, while the Oakhurst 'Smithfield' scrapers are equilateral or, more precisely, circular. B. D. Malan (1979 pers. comm.) who assisted Goodwin at Oakhurst, has said that he told Goodwin at the time that he did not think the scrapers could be considered typical of the 'Smithfield B'.

Van Riet Lowe (1929: 179), writing of the 'Smithfield B' industry in the Orange Free State, observed that the 'duckbill end-scraper' was by far the most common implement. In the scrapers from BNK 1 layers 10–13 those that can be called 'duckbill', even though they may be end-scrapers, are few (cf. Fig. 15B; although this example is from layer 6 it is typical of the 'duckbill' scrapers in the BNK 1 assemblage). They account for 15 per cent of the scraper total in layer 10, 19 per cent in both layers 12 and 13, and 21 per cent in layer 11. The frequencies have been quoted as percentages despite the small size of some of the samples in order to emphasize the relative paucity of their occurrence.

Schrire's analysis of the Oakhurst tool categories (Schrire 1962, tables 3–4) also shows low frequencies of this type of scraper (type 5) although there is some discrepancy between the statistics in her two tables. Table 3 gives a total of 16, whereas conversion of the percentages in Table 4 gives a total of only 8. Fagan (1960: 84) used a different typology for the scrapers from Glentyre shelter, but his class of 'long scrapers' numbers only 2, or 1.2 per cent of the scraper total. The analysis of scrapers from Matjes River Shelter layer D by Sampson (1974, table 42) gives a frequency of 16.1 per cent for 'frontal scrapers' (cf. his fig. 91.24) which is comparable with the low frequencies in BNK 1 layers 10–13.

The indications are, therefore, that 'duckbill end-scrapers' are not the predominant type in those industries in the southern Cape that may be considered analogous to the so-called 'Smithfield' at Oakhurst, which Sampson (1974: 263–270) has termed the 'Oakhurst industry'. Whether this 'Smithfield episode' occurred at Nelson Bay Cave is doubtful in view of the hiatus between about 8 000–6 000 B.P. (J. Deacon 1978: 100).

J. Deacon (1978: 92) has divided the scrapers from Nelson Bay Cave into three size groups based on maximum horizontal dimension. The sequence analysed by Deacon includes only the lower 'Wilton' deposits and, as indicated in her table 1, the frequencies in nine of the eleven layers are extremely low. Deacon's figure 4 indicates, however, that small scrapers less than 15 mm long are most common in the 'Robberg', large scrapers greater than 30 mm are most common in the 'Albany', and small are again most common in the 'Wilton' followed by medium (15–30 mm). Small scrapers are present only in the uppermost level, RB, of the 'Albany', while medium scrapers are present only in RB and the underlying layer J.

BNK 1, with almost seven times the number of scrapers recovered from the Nelson Bay Cave sequence studied by Deacon, shows marked differences in the relative frequencies of Deacon's three size classes:

BNK 1:	large 6,2 %	medium 61,1 %	small 32,7 %
NBC:	14,2 %	19,2 %	66,5 %

Although BNK 1 has a longer sequence referable to the 'Wilton' than that part of the Nelson Bay Cave sequence studied by Deacon, and although the mode for the length of the scrapers from layer 9 up is at or near 15 mm (cf. the means in Fig. 17), the size class divisions used by Deacon do not seem appropriate for the BNK 1 scrapers. The frequencies in layers 19-14 are too low to be useful, those from layer 5 up are certainly beyond the time range of Deacon's Nelson Bay Cave sample, and those for layers 13-6 may be summarized as follows:

layers 13-10:	large 13-17 %	medium 75-83 %	small 0-13 %
9-6:	5-9 %	56-60 %	37-42 %

In both groups medium scrapers are dominant, but in the upper layer group (9-6) small scrapers increase in frequency at the expense of both medium and large. In the Nelson Bay Cave sequence small scrapers are not present before the uppermost layer of the 'Albany' and become the dominant size class in the 'Wilton', although it should be borne in mind that this site lacks the equivalent sequence of BNK 1 layers 12-10. In the BNK 1 sequence it is only in layer 3 that small scrapers are the dominant size class so that although it is true that small scrapers increase in frequency in the upper layers of BNK 1 it cannot be said that they are the dominant size class, as is the case in the Nelson Bay Cave 'Wilton' layers studied by Deacon.

H. J. Deacon (1976, table 15) has given dimensional data for scrapers from Melkhoutboom. There were apparently no scrapers from the 'Albany' units MBS and RF (cf. tables 10-11) so that discussion is limited to the 'Wilton' units at Melkhoutboom and the upper layers at BNK 1.

The means for length and thickness of the Melkhoutboom scrapers are similar to those of BNK 1 layer 8 and above. The Melkhoutboom scrapers are generally narrower than those from BNK 1 although those from the two CAF units are similar to those from BNK 1 layers 8, 5 and 4. The CAF units are, however, younger than the BNK 1 layers mentioned, falling within the time range of layer 1.

Comparison of the means for the three dimensions and the length : width ratios of the scrapers from Wilton (J. Deacon 1972, Appendix A, tables 1-4) reveals very little similarity between these and those for the BNK 1 scrapers. (For purposes of comparison, Deacon's width:length ratios have been converted to length:width ratios by dividing them into 1.) Although the Wilton scrapers show decrease-increase trends that may be considered analogous to those of BNK 1 layers 10-6 and 5-1, there are few points at which the scrapers can be said to be morphologically similar (cf. also J. Deacon 1972, figs. 9, 11, 13, 15). The distribution of scrapers in Wilton layer 4A, in low frequencies across a wide range, is broadly similar to the distribution in BNK 1 layer 10 but, whereas about a third of the Wilton scrapers are longer than 35 mm (J. Deacon 1972, fig. 8), only three of the sixty-eight in BNK 1 layer 10 are.

The metrical analyses of the scrapers from Buffelskloof (Opperman 1978, tables 5–8) show trends from layer ZJ3 up that are broadly similar to those from BNK 1 layer 13 up. The Buffelskloof length:width ratios, however, show a trend from equilateral to wider shapes that starts at the bottom of the sequence in layer HE2 but does not move into longer shapes as in the case in BNK 1 layers 13–11. The scrapers from BNK 1 layers 13–5 are, however, metrically more like those from Buffelskloof layers ZJ3–BOL1 than they are like those from Melkhoutboom or Wilton. Layer ZJ3 has not been dated, but the inferred date for this layer, and the date for layer BOL1 (Opperman 1978: 21), suggest a broad contemporaneity with BNK 1 layers 13–5.

Adzes, termed ‘slugs’, were included in artefact collections from ten sites in the southern to western Cape that contained an industry of which these were considered by Rudner & Rudner (1954: 103) to be the type implement. Nine of these sites are coastal and are located from Sandy Bay on the west coast of the Cape Peninsula to Arniston (Waenhuiskrans) east of Cape Agulhas (Fig. 1). The tenth site, Het Kruis, is in the western Cape, about 30 km south-west of Clanwilliam and about 40 km from the coast.

In the samples from all sites except the most easterly, Hawston and Arniston, which are closest to BNK 1, and the single inland site, Het Kruis, ‘slugs’ or adzes outnumber scrapers in frequencies that range from 52,9–80,1 per cent of the artefact total. In the three samples in which scrapers outnumber adzes, frequencies for the latter range from 16,7–23,1 per cent of the artefact total. Because of the apparent association of adzes with ‘Smithfield B’ artefacts at Het Kruis and because of the resemblance of the ‘slugs’ to artefacts from ‘Smithfield N’ assemblages in Natal, Rudner & Rudner (1954: 106) ascribed the ‘Sandy Bay industry’ to the ‘Smithfield Culture-complex’ and suggested (p. 107), on the evidence of the Cape Hangklip sites, that this industry appeared to antedate the ‘Wilton’.

The Rudners’ inventories include only ‘slugs’, scrapers, bored stones and grooved stones, although two segments and a borer were reported (p. 105) from the Hout Bay midden. Potsherds were reported from Sandy Bay (p. 103), Hout Bay, and Hangklip West (p. 105), also Hawston (p. 106). In a later paper the Rudners (1956: 80) listed only the ‘type site’, Sandy Bay 1, and Hout Bay as locally representative of ‘the Sandy Bay Variation of the Smithfield Culture’, Noordhoek being described (p. 79) as ‘Wilton’.

Sampson (1974: 414) comments that while ‘worked-out’ adzes are present in ‘Wilton’ deposits, ‘more work will be needed to determine whether the Sandy Bay group represents a discrete cultural tradition, a later industry, or merely an activity (or regional) variant of the Wilton in this area’.

Another view is that of Mazel & Parkington (1978: 382) who, after comparing the Rudners’ scraper:adze ratios with those of other coastal and inland sites in the western Cape, suggested that ‘in the case of the adze-dominated assemblages this relates not to coastal settlement but to increased

woodworking activities, probably associated with underground plant food gathering and the availability of suitable wood resources'.

Adzes were not found at Nelson Bay Cave, either in that part of the sequence studied by J. Deacon or in the upper part of the 'Wilton' deposit excavated by Inskeep (J. Deacon 1978; 1981 pers. comm.).

Adzes are common only in the CAF and OMB units at Melkhoutboom (H. J. Deacon 1976, table 10) but are outnumbered by scrapers by a ratio of about 3:1. These layers fall within the time range of BNK 1 layer 1, in which adzes are more numerous than scrapers (Table 7).

At Wilton (J. Deacon 1972, table 1) adzes were recovered from layers 3G-3A in frequencies lower than 10 per cent of the tool category total. Their frequency never exceeds that of scrapers and their distribution does not seem similar to that in the upper layers of BNK 1.

Low frequencies of adzes are recorded for the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2), but frequencies are relatively high in the BLD units of this member, particularly in BLD 2a, which yielded 21 of the site total of 38. The frequency of adzes never exceeds that of scrapers as is the case in BNK 1 layer 1, within the time range of which the DGL member falls.

Opperman (1978, table 2) has recorded low frequencies of adzes from three of the upper layers of Buffelskloof, BOL1, BOL2 and CH2, as well as one from the basal layer, HE2, but the frequency of these never exceeds that of scrapers. The upper layers are probably within the time range of BNK 1 layers 4-11.

Backed scrapers were not recorded from Die Kelders (Schweitzer 1979, table 17), nor from Nelson Bay Cave, (J. Deacon 1978, table 1). Considering their distribution in the BNK 1 deposits, their absence from the Die Kelders sample is perhaps fortuitous, taking into account the very low number of retouched artefacts recovered; and it is possible that they might have been found in the upper deposit at Nelson Bay Cave excavated by Inskeep.

Goodwin (1938: 307) recorded rare 'double-edged crescents' in the uppermost Oakhurst deposits, and commented that 'on the Riversdale and Cape Peninsula coasts the single-edged type is the rarer'. Unless Goodwin was referring to very localized distributions in the specific areas mentioned, BNK 1 and Die Kelders would appear to be exceptions to Goodwin's observation. Schrire's analysis of the Oakhurst material (Schrire 1962, fig. 6, tables 3-4) records the presence of 'double crescents' (type 11) in two of the 'Smithfield C' spits and in two of the 'Wilton'. Again, however, conversion of the percentage frequencies in Schrire's table 4 does not yield the numerical frequencies given in table 3. It is thus not clear whether there were more of these artefacts in the 'Wilton' than in the 'Smithfield C' (table 3) or the opposite (table 4). In any event, the total (13 or 7) is so low as to do little more than indicate the presence of these artefacts in contexts chronologically broadly comparable with those at BNK 1 in which they also occur.

Backed scrapers are not recorded from Melkhoutboom (H. J. Deacon 1976: 59) and, although none are recorded from Wilton (J. Deacon 1972,

table 1), J. Deacon has advised (1979 pers. comm.) that these artefacts were recovered and were included with 'double scrapers'. 'Double scrapers' occur in Wilton layers 4A–3A, with maximum frequencies in layers 3F–3E. Layer 3F is probably somewhat older than BNK 1 layer 6 and about 1 000 years older than layer 5. The temporal distribution at the two sites may, however, be seen as being broadly similar.

There were apparently no backed scrapers in the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2) but at Buffelskloof Opperman (1978, table 2) recorded a total of 19 'double scrapers' from layers ZJ2–BOL1, 12 of them in BOL2 alone. This layer is probably as much as 1 000 years older than BNK 1 layer 6, but there may well be typological as well as terminological differences between the double scrapers at Buffelskloof and the backed scrapers at BNK 1 (cf., however, Opperman 1978, fig. 7.4).

In the ten assemblages from western Cape sites studied by Mazel (1978) there appears to be no clear correlation between the frequency of backed scrapers and the environment or locality of the sites. Four of the five sites in the fynbos region (the term used by Mazel to distinguish the vegetation of the inland areas from that of the Strandveld, the coastal plain and coast region) have frequencies of backed scrapers ranging from 0 to 4 per cent of the 'formal tool' category while the fifth, Koopmanskraal 2, has a frequency of 21 per cent (Mazel 1978, Appendix 3). These sites on the inland edge of the coastal plain are probably located the most analogously to BNK 1 although the climatic regimes of the two areas are very different. The five sites situated in the Strandveld have frequencies that range from 0 to 14 per cent. This suggests that BNK 1, in terms of backed scraper frequencies, has more in common with sites on the western Cape coastal plain than with those on its inland margin, which is generally further from the coast than in the BNK 1 area. The sites studied by Mazel possibly fall within the range of dates for BNK 1 layers 2 and 1 only (J. Parkington 1979 pers. comm.). Both these layers have minimal frequencies of backed scrapers (Table 7).

Segments are surprisingly abundant at Die Kelders, considering the largely informal nature of the stone artefact assemblage. They outnumber scrapers by almost 5:1 and account for 46,8 per cent of the total of 'formal tools' (Schweitzer 1979, table 15). Quartz is the predominant raw material (Schweitzer 1979, table 14), which accords with the chronologically comparable situation in BNK 1 layer 1 (cf. Fig. 14), although in this layer scrapers outnumber segments by rather more than 2:1 (Table 7).

Goodwin (1938: 304–17) recorded the recovery of upwards of forty stone 'crescents' from the 'Wilton' layers at Oakhurst, as well as half a dozen from the deposit immediately underlying his 36-inch (91,4 cm) test spit. These Goodwin also associated with the 'Wilton'. Another dozen segments were recovered from the 'Smithfield C' deposits but it is not clear whether the six included in Goodwin's inventory for the 40–45 inch (102–114 cm) spit are the same as those referred to above.

Segments were most abundant at the 'Smithfield C-Wilton' interface, with the next to highest frequencies at the top of the 'Wilton' deposit. This deposit was also remarkable for the great number of 'crescents' made of the shell of the black mussel *Choromytilus meridionalis* (*Mytilus edulis* in Goodwin's text). Only about a dozen of these were recovered from the 'Smithfield C' levels but Goodwin (1938: 322) considered that they, as well as the stone segments, should be ignored as intrusive material brought into the lower deposit by the human burials. Goodwin (1938: 304) also considered that in the 'Developed Wilton' segments made of shell largely replaced those made of stone.

Schrire (1962, table 3) recorded 23 segments (type 10) from the 'Smithfield C' levels and 28 from the 'Wilton', which conflicts somewhat with the previously mentioned observations by Goodwin. However, conversion of the percentage frequencies in Schrire's table 4 gives a total of 18 segments in the 'Smithfield C' levels (36-60 inches) and 9 in the 'Wilton' (0-36 inches). There is thus little clarity regarding the distribution of segments in the two units.

In the BNK 1 sample segments are most common in layers 9-5, layer 5 having the highest frequency, AD as well as actual. If layers 12-10 are considered the equivalent of the 'Smithfield C' at Oakhurst and layer 5 to the 'Developed Wilton', then the correspondence between the two sites, where segments are concerned, is not close. Shell 'crescents' were not recovered from the deposits at BNK 1, although they are recorded from Die Kelders (Schweitzer 1979: 153, 155).

Two segments were recovered from the 'Robberg' layers at Nelson Bay Cave, none from the 'Albany' and 32 from the 'Wilton', of which 23 came from the uppermost layer, IC, excavated by Klein (J. Deacon 1978, table 1). In the BNK 1 sequence segments are present only in layers 17 and 16 of the layers chronologically comparable with the 'Albany' of Nelson Bay Cave, but present in every layer from 12 up. The increasing frequency of segments in BNK 1 layers 9-5 and in the 'Wilton' of Nelson Bay Cave is similar, as is their relative frequency in the 'formal tool' or retouched artefact category: 12,6 per cent of the 'Wilton' total at Nelson Bay Cave and 13,6 per cent of the total for BNK 1 layers 9-5. However, whereas segments account for 76,2 per cent of the backed tool class in the 'Wilton' sample from Nelson Bay Cave, they account for only 39,8 per cent of the class total in BNK 1 layers 9-5. The BNK 1 class of backed pieces includes relatively high frequencies of backed scrapers in these layers, an artefact type that is absent from the Nelson Bay Cave 'Wilton' sample.

H. J. Deacon (1976: 59) has observed that all the segments from Melkhoutboom were made from flakes, and his table 12 shows that chalcedony is the predominant raw material, with 20 per cent or less in each layer made of quartz and/or other raw materials. The segments are restricted to the 'Wilton' layers and Deacon's table 25 indicates that they were more common in the lower layers M-MB than in the upper CAF-S, a situation analogous to that at BNK 1 although the M-MB layers may be somewhat older than BNK 1 layers 9-5. The mean length of the Melkhoutboom segments is within the range of variation of

the quartz segments from BNK 1 but the mean width is less than that of the quartz and silcrete segments in layers 9–5. The mean length:width ratios (converted from Deacon's width:length ratios) are comparable with those of BNK 1 layers 10, 9 and 5–1 and indicate a more elongate shape than those in layers 8–6.

Segments from Wilton were relatively fewer than from BNK 1, accounting for only 4,0 per cent of the tool category and 32,6 per cent of the backed tool class (J. Deacon 1972, table 1, including broken segments). Segments account for 11,6 per cent of the retouched artefact category in the BNK 1 sample, and 40,9 per cent of the backed artefact class. They are most common in Wilton layer 3F, which is somewhat older than BNK 1 layer 5, which has the latter site's highest layer frequency. The Wilton segments are predominantly silcrete and their mean length and width (J. Deacon 1972, fig. 5; Appendix A, table 8) are within the range of those from BNK 1 layers 6–4. The average shape of the Wilton segments is one in which the length is about three times the width while in the BNK 1 segments the length is only 1,5–2,5 times the width.

Only two segments were recovered from the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2). The BLD–BLD 1 and BLD 2 units from which these came are within the upper time range of BNK 1 layer 1 which has a relatively high frequency of segments: 14,8 per cent of the retouched artefact category and 80,4 per cent of the backed artefact class.

At Buffelskloof Opperman (1978, table 2) recovered 104 segments, including broken pieces. None were found below layer CH3 and slightly more than half the total came from layer BOL2 alone. This layer is about 1 000 years younger than BNK 1 layer 9 and about 1 200 years older than layer 5. The range of variation in the relative frequencies in the Buffelskloof layers is, however, not great and is much the same as that in BNK 1 layers 10, 8 and 7, all of which probably fall within the time range of the Buffelskloof layers. Layer BOL1, which is approximately coeval with BNK 1 layer 5, has a low frequency of segments, which account for only 5,9 per cent of the tool category, compared with 14,6 per cent for BNK 1 layer 5. The mean length of the Buffelskloof segments (Opperman 1978, table 16) is similar to that of the silcrete segments from BNK 1 layers 9–7 and those in quartz from layer 6. The mean width decreases from layer CH3–MDA and increases slightly in BOL1. The segments in layer CH3 are similar to the quartz and silcrete segments in BNK 1 layer 6, which are the widest of all the BNK 1 segments (Fig. 22), while those from layers MDA and BOL1 are similar to the quartz segments from BNK 1 layers 5 and 4. In shape the Buffelskloof segments appear to follow a reverse trend to that of the BNK 1 segments, being wider in layer CH3 than in the overlying layers while in the BNK 1 segments the trend is for an increase in width from layer 9 to layer 6 and, after the anomalous reversion to a longer shape in layer 5, the wider shape continues in the upper layers. A denticulate segment similar to those from BNK 1 layers 9 and 12 (Fig. 20H) came from one of the approximately contemporary Buffelskloof layers, CH1–CH3, although it

is somewhat larger than the BNK 1 segments, being approximately 15 mm long (Opperman 1978, fig. 8.9).

Mazel (1978: 87) does not separate segments from his general class of backed pieces, though they are listed separately in the inventories in his Appendix 3. Segments are numerically most common at the two 'lacustrine' sites, Uithoek and Verlore. Five of the other eight sites have 'formal tool' totals ranging from 13 to 67 which makes comparison of the relative frequencies in the various classes with those from BNK 1 of doubtful value. It seems, though, that although segment frequencies are low, they are higher at sites on the coastal plain than at sites in or near the mountains.

J. Deacon (1974: 17) has observed that 'assemblages from southern Rhodesia and South Africa with more than 10 per cent of segments relative to scrapers are likely to date to the middle of the Holocene sequence, while those with more than 50 per cent segments in relation to other backed tools are likely to be older than 4 000 B.P. It seems reasonable to propose that segments can be regarded as a time-controlled feature or a "Temporal Type" in the later Stone Age sequence in southern Africa and that they can be expected to occur in quantity in horizons dated to between 7 000 and 3 000 B.P.'. Although part of BNK 1 layer 1 falls within Deacon's 7 000–3 000 B.P. time bracket, segments account for 31,5 per cent of the scraper-segment total and for 61,2 per cent of the total of backed artefacts (Table 7). The Die Kelders Holocene deposits, all of which are younger than 3 000 B.P., yielded 29 segments but only 6 scrapers and 7 other backed artefacts (Schweitzer 1979, table 15) and thus also presents a deviation from Deacon's suggestions regarding the temporal distribution of segments.

Backed flakes in the Die Kelders assemblage were included in the class of 'other backed tools', of which there were only six (Schweitzer 1979, table 15). There were also few of these artefacts in BNK 1 layer 1.

There were apparently no backed flakes from Oakhurst (Schrire 1962, fig. 6; tables 3–4). They might have been included with scrapers, although Goodwin (1938: 314), in commenting on the 'Smithfield C' deposit from which over 5 000 white quartz scrapers were recovered, mentioned that 'in addition there are some two hundred flakes of brown chalcedony, carefully used and showing perfect cleavage, yet only in a dozen instances has any attempt been made to trim these into implements'. This observation may also be taken to indicate that there were no recognizable backed flakes in the overlying 'Wilton' deposits since Goodwin (1938: 307, 310, 313) does not mention them.

There were only 5 backed flakes and bladelets from Nelson Bay Cave, 2 in the 'Robberg' levels and 3 in the 'Wilton' (J. Deacon 1978, table 1).

Backed flakes are not listed separately in the inventories of artefacts from Melkhoutboom (H. J. Deacon 1976) although Deacon's table 9, which is concerned with raw material frequencies, has two categories of flakes, unmodified and retouched. Frequencies of retouched flakes in layers M and W are particularly high, accounting for 33,2 and 42,9 per cent of the site total, and the

total for layer M alone (146) exceeds the BNK 1 site total for backed flakes. There were more retouched flakes in the 'Robberg' layer B than in the 'Albany' layers RF and MBS, but 93,2 per cent of the retouched flakes are in the 'Wilton' layers WBM-OMB, a situation analogous to that of BNK 1 where 94,4 per cent of the backed flakes are in layers 9-1.

There are only 21 backed flakes in the Wilton stone artefact inventory (J. Deacon 1972, table 1). Their maximum occurrence is in layers 3F and 3E, which may be approximately coeval with BNK 1 layers 6 and 5. These layers mark the end of the period of relatively high frequency that began in layer 9.

Only three backed flakes and blades are recorded from the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2) and these come from the lowest part of the member, layers BLD 2 and 2a.

Of the twenty backed flakes from Buffelskloof (Opperman 1978, table 2), twelve came from layer BOL2 which is possibly about the same age as BNK 1 layers 8-7.

Mazel (1978, Appendix III) does not have a separate class of backed flakes and if there were any recovered they are probably included in his class of miscellaneous backed pieces.

Backed blades were rare at Oakhurst, only two being recorded from the lowest of the 'Wilton' levels (Schrire 1962, tables 3-4).

Although bladelet cores are considered a diagnostic feature of the 'Robberg' industry at Nelson Bay Cave and 'a number' of unworked bladelets were recovered, a total of only five backed flakes *and* bladelets is recorded from the site (J. Deacon 1978: 88, 100; table 1; fig. 4). Two were from the 'Robberg' levels and three from the 'Wilton'. This suggests that if blades were being produced in any quantity they were not being backed or were used and abandoned away from the site more than at it.

At Melkhoutboom (H. J. Deacon 1976, tables 10-11) backed bladelets were recovered in low frequencies (maximum 6) from all the 'Wilton' layers except the lowest, WBM. In contrast a total of 122 backed bladelets was recovered from Highlands Rock Shelter in the Cradock district (H. J. Deacon 1976, table 44). These came from the Upper Member, for which a maximum date of $4\,500 \pm 60$ years B.P. was obtained. Deacon (1976: 129) has interpreted the virtual lack of segments at Highlands (only one was found) and the abundance of backed blades, compared with the reverse situation at Melkhoutboom, as indicating 'a significant difference in formal hafted tool design and preference' reflecting 'some measure of social distance'.

Over 100 backed blades and snapped backed blades were recovered from Wilton (J. Deacon 1972, table 1). These were most common in layers 3F (31) and 3C (27), which are possibly contemporary with BNK 1 layers 6-4, from which just over half the site total of backed blades came. The frequencies of these artefacts from Wilton are, however, very different from all the sites discussed so far except Highlands, and it is of some interest that the name site of the 'Wilton industry' should, even in one respect, have more in common

with a 'Smithfield' site (H. J. Deacon 1976: 168-169) than with other sites containing 'Wilton' deposits.

At Boomplaas only three backed 'flakes/blades' were recovered, from the basal units of the DGL member (H. J. Deacon *et al.* 1978, table 2) while Opperman (1978, table 2) recorded twenty-six backed blades from Buffelskloof. These came from the uppermost layers, MDA-BOL1, with BOL2 alone contributing twenty-three. These layers may be the same age as BNK 1 layers 7-4, from which almost half the site's backed blades were recovered.

In the samples from the western Cape sites studied by Mazel (1978, Appendix III), frequencies of backed blades are generally low, ranging from 0 to 5 per cent of the 'formal tools'; but at three sites, Kookfontein, Koopmanskraal and Verlore, they account for 6 to 10 per cent. Mazel (1978: 87) has observed that backed pieces (as a class, including backed blades) have higher frequencies at sites in the Sandveld (*sic*) than at those in the mountains, but there is no clear correlation between the frequency of backed blades and locality. For example, the Verlore and Uithoek sites are only about 10 km apart and both are on the coastal plain, although Verlore is rather closer to the sea and to the Verlore Vlei lagoon. Backed blades account for 9,7 per cent of the Verlore 'formal tools', while at Uithoek they account for only 1,5 per cent. Conversely, at Koopmanskraal and Kookfontein backed blades account for 6 per cent of the category total at each site, though the former is in the interior of the coastal plain and the latter near the mountains.

Borers were minimally represented at Nelson Bay Cave by two in the lower 'Wilton' layers RA and BSC (J. Deacon 1978, table 1). These layers are about the same age as, or slightly younger than BNK 1 layers 10 and 9.

Borers were similarly restricted to the 'Wilton' layers at Melkhoutboom (H. J. Deacon 1976, tables 10-11) with maximum frequencies of 10-12 in the M and MB units, which are contemporary with BNK 1 layer 10 and some of the overlying layers.

There were also few borers in the Wilton sample (J. Deacon 1972, table 1). They have their maximum frequency (8) in layer 3F, which is about 1 000 years older than BNK 1 layer 5.

One borer is recorded from the basal unit, BLD 2a, of the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 2) while eight were found at Buffelskloof, sporadically distributed through layers HE1-BOL2 (Opperman 1978, table 2). These layers span the probable time range of BNK 1 layers 13-7.

Borers were recorded from only 5 of Mazel's 10 western Cape sites (Mazel 1978, Appendix III), with only Koopmanskraal and Verlore, each in a different environment, yielding more than 10, Verlore having a high total of 54, although these account for only 3,9 per cent of the 'formal tools', a frequency similar to that for BNK 1.

Notched flakes are something of a typological or terminological problem in the inter-site comparisons. Schrire (1962: 191) mentions the presence of 'small

saws' in the 'Smithfield B' assemblage from Oakhurst, but her inventories in figure 6 and tables 3 and 4 list a separate category of 'denticulates' (type 7). These are most common in the 'Smithfield C' but are also present in the 'Wilton' and possibly also in the 'Smithfield B': two are listed as from these deposits in Schrire's table 3 but do not appear in figure 6 or table 4. In the BNK 1 assemblage denticulates are more common in the upper layers than in the lower, a situation different from that at Oakhurst.

Sampson (1974, table 71) has listed the presence of 'notched scrapers' in assemblages from five southern Cape sites, from Nelson Bay Cave to Klasies River Mouth and Andrieskraal I. J. Deacon (1978, table 1) has, however, included the notched pieces from Nelson Bay Cave in the category of utilized artefacts rather than with the 'formal tools'. Over 500 notched flakes were recovered, a situation very different from that at BNK 1, and they were recovered from every layer, showing, as does the BNK 1 sample, that this is an artefact type that transcends 'industrial' divisions. Only seven 'notched scrapers' were recorded from Andrieskraal I (J. Deacon 1965, table 1), and the Klasies River Mouth data are still to be published.

At least three of the 'slugs' from Sandy Bay (Rudner & Rudner 1954: 104 figures 4-6) would fit into the class of notched flakes as defined for the BNK 1 assemblage except that one, no. 6, has scraper retouch as well. No. 5 is described in the caption as a 'serrated slug' and Sampson (1974, fig. 153.3) reproducing the same illustration, has called it a 'denticulate piece'.

BONE ARTEFACTS

Although the sample of bone artefacts from BNK 1 is much smaller than those from Die Kelders (Schweitzer 1979, table 2) and Nelson Bay Cave (J. Deacon 1978, table 4) it covers much the same range. Where BNK 1 differs significantly from Nelson Bay Cave, however, is that bone artefacts were sufficiently abundant in the 'Albany' layers to allow J. Deacon (1978: 104) to postulate that 'the reaction of the people in the southern Cape to the environmental changes coincident with a rising sea level and warmer conditions at the end of the Pleistocene . . . was [*inter alia*] . . . to make a wide range of bone rather than stone Formal Tools'. In BNK 1 layers 18-10, even though retouched stone artefacts are relatively rare, particularly in layers 18-13, they outnumber bone artefacts by 31:1, or 23:1 if scrapers are excluded. In the 'Albany' layers of Nelson Bay Cave bone artefacts exceed retouched stone by 2:1 or almost 28:1 if scrapers are excluded. The BNK 1 evidence for the lower layers points to a lower degree of occupation rather than a major change in the traditions of artefact manufacture. Bone artefacts seem to be more common at coastal sites than at inland ones (cf. J. Deacon 1972: 14 *re* Wilton; H. J. Deacon 1976: 49 *re* Melkhoutboom, table 39 *re* Highlands; H. J. Deacon *et al.* 1978, table 6 *re* Boomplaas; Opperman 1978: 21 *re* Buffelskloof) and BNK 1 seems intermediate between the two groups.

Fish gorges have a much greater temporal restriction at BNK 1 than at Nelson Bay Cave, where they were found in every layer from the final 'Robberg' (BSL) to the first 'Wilton' (RA) thus spanning the period from about 12 000 to 6 000 B.P. (J. Deacon 1978, fig. 3, table 4). In the BNK 1 sample they are present only in layers 15–13 which perhaps span the period 10 000–8 000 B.P. Parkington (1980b: 317) reports the presence of about 800 of these artefacts at Elands Bay Cave, mostly in layer 12, which is dated to around 9 600 B.P.

Ornaments from BNK 1 cover a wider range than the sample from Die Kelders (Schweitzer 1979: 137, fig. 18D) but not unlike that from Nelson Bay Cave, where they were found in most layers but chiefly in the 'Albany' and 'Wilton' (J. Deacon 1978, table 4).

MARINE SHELL ARTEFACTS

Ornaments similar to those from BNK 1, apart from those made from *Donax serra*, were also found at Die Kelders (Schweitzer 1979, table 4) although the relative frequencies of the different types at the two sites differ. *Nassa kraussiana* beads as well as perforated *Donax serra* were recovered at Melkhoutboom (H. J. Deacon 1976, figs 28.2, 29) and *Nassa kraussiana* beads are also recorded from the DGL member at Boomplaas (H. J. Deacon *et al.* 1978, table 10).

Pendants from BNK 1 have shapes in common with those from Die Kelders (Schweitzer 1979, fig. 21) although the latter lack the triangular shape (Fig. 35A, 36D–G), nor do any of the Die Kelders pendants have decorated edges.

The illustrations of the ornaments from Oakhurst (Goodwin 1938, figs 18–62) do not always receive comment in the text but it is evident that shell ornaments, including pendants, were recovered from the 'Wilton' layers. Goodwin (1938: 316) does mention that nacre ornaments were found in the 'Smithfield C' deposits though these were rare and came from the upper 9 in. (23 cm).

Shell ornaments are not recorded from the lower 'Wilton' deposits at Nelson Bay Cave excavated by Klein (J. Deacon 1978) but were recovered from the upper deposits excavated by Inskeep and include designs similar to that from BNK 1 shown in Figure 36I (Inskeep 1978, fig. 15).

Pendants made of *Turbo* sp. shell are recorded from the W unit at Melkhoutboom which is dated to between 6 980–5 900 B.P. (H. J. Deacon 1976, fig. 28; table 2). This makes their occurrence approximately contemporaneous with their first appearance at BNK 1. The Melkhoutboom pendants are mostly circular to oval and are unperforated as well as perforated, and four of the six illustrated have notched or denticulate edges. This type of decoration, occurring at BNK 1, Nelson Bay Cave and Melkhoutboom, appears to have been widespread.

Edge-damaged Donax serra valves or fragments were recovered in fairly high frequencies from Die Kelders (Schweitzer 1979, fig. 23, table 10). They

are also recorded, in small numbers, from Oakhurst (Goodwin 1938: 307) and apparently came only from the 'Wilton' layers. At Melkhoutboom, *Donax serra* is present throughout the entire sequence (H. J. Deacon 1976, table 4a), but it is not recorded when edge-damaged pieces first appear. H. J. Deacon (1976, fig. 29) has suggested that the edge modification could have resulted from utilization 'although a very similar edge results in [*sic*] removing the central part of the valve'. At Elands Bay Cave, *Donax* 'scrapers' were recovered from layers dated at about 8 000 B.P. (Parkington 1979: 11), at about the same time as they first appear at BNK 1, but apparently earlier than at Oakhurst.

OSTRICH EGG-SHELL ARTEFACTS

Decorated ostrich egg-shell was not found at Die Kelders, nor were any pendants (Schweitzer 1979: 149–50). Fragments of 'flask' openings were found, however, and this suggests that their absence from BNK 1 layer 1 is probably fortuitous.

The presence of decorated ostrich egg-shell in the 'Smithfield C' deposits at Oakhurst (Goodwin 1938: 317; fig. 60) supports the evidence from BNK 1 that the practice of decorating ostrich egg-shell was not confined to the 'Wilton', and the presence of fragments decorated with the 'ladder pattern' (Fig. 37B–C) at Boomplaas (H. J. Deacon *et al.* 1978, fig. 12.6–7) indicates that this type of decoration is not locally restricted.

POTTERY

There is little that can be said about the pottery from BNK 1 except that the sherds point to a relationship with the pottery from the upper layers of Die Kelders (Schweitzer 1979: 162–169) and fall within the general range of coastal pottery described by Rudner (1968). The *Donax*-impressed decoration (Fig. 38A–B; Schweitzer 1979, figs 30, 31A) cannot be claimed as part of a distinctive tradition restricted to the Agulhas region since similarly decorated sherds have been recovered from Diepkloof, near Elands Bay Cave (Wilson 1974, fig. 17.3–5), and possibly elsewhere (cf. Rudner 1968, figs 6.1, 10.6, 31.51). In passing, it is perhaps worth mentioning that in the only known painted site in the Agulhas region, a cave in the Kleinriviersberge some kilometres east of Stanford, are hand-prints with semicircular patterns similar to those at Elands Bay Cave (W. van Ryssen 1981, pers. comm.).

Spouted pots have been found at coastal sites from the Saldanha area to East London (Rudner 1968, table 6) and Rudner (1968: 455) mentions that they have also been found at inland sites.

METAL ARTEFACTS

Metal artefacts are rare in Late Stone Age deposits in the southern Cape, possibly because metal in its raw form was not readily available and most of the Khoisan peoples of the area might have lacked the knowledge necessary for its

extraction and processing. If metal artefacts were scarce they would have had added value as objects of status, or for barter, and they might have been considered too valuable to be discarded even when worn out or broken, or to be buried with their owners.

Goodwin (1956: 50) is unlikely to be correct in his assertion that 'the Cape Hottentots had no metals and no knowledge of metal-working in 1650'. In the earliest record of contact between voyagers from Europe and the local inhabitants of the Cape, which took place at St. Helena Bay in November 1497, the writer of the journal of Vasco da Gama's voyage recorded that the Portuguese traded the artefacts of the inhabitants for small copper coins and observed: 'From this it seemed to us that they prized copper; and they also wore small beads of it in their ears' (Raven-Hart 1967: 4). St. Helena Bay is about 130 km distant from Table Bay (Fig. 1) and it seems unlikely that the inhabitants of the Cape Peninsula would not have had access to copper artefacts, especially when the Cochoqua or 'Saldanhars' are considered, whose annual pastoral migration included the whole of the coastal area between the two bays. If, as seems likely, the source of the metal was the north-western Cape, movement of the metal from tribe to tribe quite possibly extended along the southern Cape as well. In any event, extracts from the journals of visitors to the Cape prior to 1652 (Raven-Hart 1967) provide abundant testimony of an awareness of the uses of metals, particularly copper and brass, to the extent that, as Goodwin (1956: 47) himself observed, they were 'willing to trade their beloved cattle to obtain it'.

The Namaqua, whose territory lay in the north-western Cape, certainly had the ability to extract and work the copper ores that are still mined in the vicinity of Springbok, as testified to in the records of the expeditions by Meerhof in 1661 (Moodie 1838: 400-412) and Simon van der Stel in 1685-6 (Waterhouse *ed.* 1932). There seems little reason to doubt that the copper plates and beads produced by the Namaqua would have been traded with the tribes to the south, even though the mechanics of trade among the early Khoisan are still poorly understood.

In any event, it is quite clear from the early records that by the end of the seventeenth century, the date indicated for the bead from BNK 1, a considerable quantity of metal had been in circulation among the Khoisan for a century or more. It would be interesting to know what became of it all.

MAMMALS

The mammalian fauna from Die Kelders (Schweitzer 1979, table 27) covers as wide a range as that from BNK 1 layer 1. There are thirty-two taxa in the Die Kelders sample as against twenty-seven in BNK layer 1. Nine taxa in the Die Kelders sample are not present in the BNK 1 layer 1 sample: ?*Canis familiaris*, *Genetta* sp(p)., *Felis* cf. *serval*, *Mirounga leonina*, *Loxodonta africana*, ?*Bos taurus*, *Tragelaphus scriptus*, *Pelea capreolus* and Cetacea. Of these, *Loxodonta africana* and *Pelea capreolus* are both present in BNK 1 layer 4 and

below, suggesting a chance element in their absence from layer 1. Present in the BNK 1 layer 1 sample but absent from the Die Kelders sample are *Aonyx capensis*, *Herpestes ichneumon*, *Hyaena brunnea*, and *Felis* cf. *caracal*. It is possible that the felines from the two sites may be the same species, and none of the others are so habitat-specific that they would be restricted to one side of the Franskraal Mountains or, in the case of *Mirounga leonina* and the cetaceans, to Walker Bay, although this is a favoured area for whales in the breeding and calving seasons. There is one positively identified *Damaliscus dorcas* in the Die Kelders sample as well as another six probable identifications. This raises problems with regard to the ascription of the absence of this species from BNK 1 after layer 11 to environmental factors: unless these antelope are not predominantly grazers, the eastern side of Walker Bay is, and probably has been for the past few thousand years, a less likely habitat than the area to the east of BNK 1 (cf. Schweitzer 1979: 113–114, and the section on vegetation in the present report).

The Die Kelders sample ($n = 2\,017$) is considerably larger than that from BNK 1 layer 1 ($n = 90$) but, while both are numerically dominated by *Bathyergus suillus*, at Die Kelders this species accounts for 71,5 per cent of the total whereas in BNK 1 layer 1 it constitutes only 41,1 per cent of the total. The size class distribution of all animals in both samples is largely similar, with frequencies generally ranked inversely to size, i.e. very small animals are most common, very large least so.

After *Bathyergus suillus* the most common species at Die Kelders are *Raphicerus* spp. and *Arctocephalus pusillus*, followed at some distance by *Ovis aries*. In the BNK 1 layer 1 sample *Raphicerus* spp. also rank second but *Ovis aries* ranks third and is followed by *Syncerus caffer*, which ranks only sixth at Die Kelders. As at BNK 1, identified *Raphicerus melanotis* is more common at Die Kelders than *R. campestris*. *Arctocephalus pusillus* accounts for only 5,0 per cent of the Die Kelders site total, but this is higher than at BNK 1, where it accounts for 2,2 per cent of the layer 1 total and 2,5 per cent of the site total.

Comparison of the BNK 1 mammals with those from Nelson Bay Cave on the basis of comparable chronology is restricted to Nelson Bay Cave layers BSL–IC and BNK 1 layer 19 to somewhere between layers 9 and 5. Account must also be taken of the hiatus in the Nelson Bay Cave sequence between layers RA and RB (J. Deacon 1978: 100–101), which covers the period of deposition of BNK 1 layers 13/12–10.

The Nelson Bay Cave mammals have been analysed by Klein (1972a, 1972b, 1974) and a later paper (Klein 1976a) has frequency diagrams that include data from the upper levels excavated by Inskeep. The most complete numerical data are, however, in Klein's third paper and it is these that have been used for the present comparison. In this paper Klein (1974, table 4) has grouped the frequencies into 'Robberg', 'Albany' and 'Wilton' units which may be considered as broadly analogous to BNK 1 layers 19–18, 17–13/12 and 9–6.

However, for the purpose of the present comparison the BNK 1 sample is simply divided into the lower layers, 19–10, and the upper, 9–1.

The Nelson Bay Cave sample is some 30 per cent larger than that from BNK 1 and contains forty taxa, of which sixteen are bovids. More than half (52,7 %) of the individuals are in the 'Wilton' deposits, with 28,9 per cent in the 'Albany' and 18,3 per cent in the 'Robberg'. In the BNK 1 sample 64,4 per cent of the site total came from layers 1–9, 27,2 per cent from layers 10–17 and 8,4 per cent from layers 18 and 19.

There are 27 species in the 'Robberg' of Nelson Bay Cave, 27 in the 'Albany' and 25 in the 'Wilton'. This indicates that, as was the case at BNK 1, although there was some shift in the species hunted, the change was more in the frequency with which certain species were procured rather than in a broadening of the range.

Taxa common to both sites but restricted to the 'Robberg' at Nelson Bay Cave are *Hyaena brunnea*, *Equus* cf. *quagga*, *Redunca arundinum*, *Damaliscus* sp., and possibly *Connochaetes* sp. and *Lepus* cf. *capensis*. Of these, *Hyaena brunnea* is found at BNK 1 up to layer 1, *Equus* cf. *quagga* up to layer 9, *Redunca arundinum* up to layer 6, *Damaliscus dorcas* up to layer 11, and *Connochaetes/Alcelaphus* and Leporidae up to layer 1.

Species restricted to the 'Robberg' and 'Albany' at Nelson Bay Cave include *Phacochoerus aethiopicus*, *Oreotragus oreotragus* and *Taurotragus oryx*. *Phacochoerus aethiopicus* was found only in layer 13 at BNK 1, *Oreotragus oreotragus* sporadically up to layer 1, and *Taurotragus oryx* in layers 19–16 and 7. There are no species common to both sites that are restricted to the 'Albany' at Nelson Bay Cave and are not also found in the lower layers of BNK 1.

Species restricted to the 'Wilton' at Nelson Bay Cave are *Aonyx capensis*, *Atilax paludinosus*, and *Felis libyca*. *Aonyx capensis* was found at BNK 1 only in layers 4 and 1, and *Atilax paludinosus* only in layer 14 while *Felis libyca* was present sporadically in layers 19–13, then in every layer from 6 up. Eleven species, seven of them bovid, as well as Delphinidae, are not present in the BNK 1 sample. Species present in the BNK 1 sample but not in that from Nelson Bay Cave are *Ictonyx striatus*, *Loxodonta africana*, *Diceros bicornis*/Rhinocerotidae, *Raphicercus campestris*, *Ovis aries*, and *Bathyergus suillus*.

Arctocephalus pusillus, of which only one doubtfully identified individual was present in the 'Robberg', is otherwise the most common species at Nelson Bay Cave and accounts for about 20 per cent of the site total, whereas at BNK 1 it ranks sixth in order of frequency and accounts for only 2,5 per cent of the site total. The bovid species account for about 42 per cent of the site total at both sites. Of these, 24,8 per cent are in the 'Robberg' at Nelson Bay Cave, 29,4 per cent in the 'Albany' and 45,9 per cent in the 'Wilton' while at BNK 1 40,9 per cent are in the lower layers and 59,1 per cent in the upper. If consideration is given to the fact that Nelson Bay has a longer 'Robberg' sequence than the comparable layers (19–18) at BNK 1, lacks the final 'Albany'

(or initial 'Wilton') and final 'Wilton' sequences, the differences in the frequencies given above may have a reduced significance.

In terms of frequencies in the size classes used for the analysis of the BNK 1 mammals, Nelson Bay Cave provides the following rankings, from highest to lowest (in the two cases where the classes are joined by 'and' this indicates that they are of equal rank):

'Robberg': very small, small medium and large medium, large, small, very large;

'Albany': small medium, small, very small and large medium, large, very large;

'Wilton': small medium, small, very small, large, large medium, very large.

It will thus be seen that the general trend is for the larger size classes to become less frequent through time, although in the 'Robberg' it is the smallest size class that predominates and in the 'Albany' and 'Wilton' there is only a difference in the ranking of the large and large medium size classes and in each case the three smaller size classes have the highest ranking.

The lower layers of BNK 1 may be divided into two groups on the basis of size class ranking. Layers 19–16 have the very small and large medium size classes in the first two rankings, with small, small medium or large ranking third. Layers 15–11 have large medium ranking first and two of the three smaller size classes ranking second and third. The major difference from the 'Albany' of Nelson Bay Cave is that there it is the small medium size class that ranks highest. Where the upper layers of BNK 1 and the 'Wilton' of Nelson Bay Cave are concerned the only difference is in the ranking of the three smaller size classes, all of which rank higher than the three larger size classes.

Klein (1974: 273–276) has suggested that the presence of *Equus* cf. *quagga*, *Damaliscus* *dorcas*, *Connochaetes* cf. *gnou*, *Antidorcas* cf. *marsupialis*, and possibly also the extinct *Pelorovis* sp. and *Megalotragus* sp. 'clearly imply more open vegetation near Nelson Bay in Robberg times'. Although the 'Albany' deposits lack the predominantly grazing animals of the 'Robberg', Klein considers that the presence of *Phacochoerus aethiopicus* and *Taurotragus oryx* suggests 'more open vegetation than the historic evergreen forest'. He also observes that faunal assemblages from sites as far afield from Nelson Bay Cave as Wilton and Elands Bay Cave reveal 'a common emphasis on smaller terrestrial animals, especially very small bovids' in 'Wilton' times. Klein sees this as being 'in marked contrast to the preceding Albany and may reflect end-Pleistocene/early Holocene environmental change leading to reduction in suitable grazing for many large bovids over much of the Southern Cape'. The increased frequency of small bovids the size of *Raphicerus* is evident in the upper deposits of both sites, but appears more marked at BNK 1 because of the dominance of *Arctocephalus pusillus* in both the 'Albany' and 'Wilton' of Nelson Bay Cave.

While *Bathyergus suillus* is the dominant small animal at both BNK 1 and Die Kelders, at Nelson Bay Cave it is *Procapra capensis*, a fact no doubt reflecting the lack of a suitable sandveld environment for *Bathyergus suillus* in the vicinity of that site. Species such as *Tragelaphus scriptus*, *Sylvicapra grimmia*, and *Ourebia ourebi* reflect a variety of environments in the vicinity of the cave, but it is probably only *Tragelaphus scriptus* that might not have found a suitable habitat in the area around BNK 1, although one individual is recorded from layer 12 of Die Kelders (Schweitzer 1979, table 27). Dorst & Dandelot (1972: 223) indicate that the present distribution of this species is only east of Cape Agulhas.

The fauna from Klasies River Mouth (Klein 1976a) is mostly from M.S.A. deposits and therefore not directly comparable with that from BNK 1, although it is worth noting that the bulk of the bovids were from these levels. The samples from the L.S.A. deposits in Caves 1, 1D and 5 (Klein 1976a, tables 1, 4) are too small to allow for more than the observation that the faunal list is much the same as those for Nelson Bay Cave and BNK 1. *Arctocephalus pusillus* and *Syncerus caffer* are the most common species in the L.S.A. levels of Cave 1, followed by *Alcelaphus buselaphus* and *Raphicerus melanotis*, and *Arctocephalus pusillus* is also the most common species in Caves 1D and 5.

The faunal sample from Melkhoutboom (H. J. Deacon 1976, table 35) is much the same size as that from BNK 1. The 'Robberg' deposits (B unit) are beyond the time range of BNK 1, and show a predominance of large grazers, while the small bovid species are absent.

In the 'Albany' deposits RF and MBS the large grazers still predominate, although *Hippotragus* and *Alcelaphus* are present only in the lower unit. *Damaliscus* cf. *dorcas* is present only in this unit, in which several of the smaller species first occur. The three highest rankings in these units in the size classes for all mammals are: large medium, small medium, and small, a situation different from that for the lower layers of BNK 1.

In the 'Wilton' units at Melkhoutboom *Equus* cf. *quagga* is present only in the lowest two units and is absent after about 7 000 B.P., about 1 000 years before it disappears from the BNK 1 deposits. *Raphicerus* sp., probably *R. melanotis* on the basis of Klein's observations (see discussion at the end of this section), is the most common species, followed by *Tragelaphus scriptus* and *T. strepsiceros*. *Syncerus caffer* first appears in the lowest unit, WBM, and *Pelea capreolus* in the overlying M unit whereas in the BNK 1 sample *Syncerus caffer* is present from layer 19 and *Pelea capreolus* from layer 14. The three highest rankings in the size classes are small, small medium, and very small. The frequencies of the first two are almost equal and the distribution is thus closer to that of the 'Wilton' layers from Nelson Bay Cave than to that from BNK 1 layers 9-1.

Excluding *Homo sapiens*, the 'undetermined antelope' from the M unit and *Otomys* sp. there are 11 species in the 'Robberg' at Melkhoutboom, and 21 each in the 'Albany' and 'Wilton'. Of the total of 32 species, 22 (or the same

genera, at least) are also present in the BNK 1 sample. Some of the species in the Melkhoutboom sample, but not in that from BNK 1, have a preference for a more closed habitat, e.g. *Tragelaphus scriptus*, *T. strepsiceros*, and *Cephalophus monticola*, while others such as *Sylvicapra grimmia* and *Ourebia ourebi* prefer more open habitats, suggesting a mosaic of vegetation types in the area. The absence of any of the species from the various units at Melkhoutboom, particularly in the upper units, may be attributable to chance: as at BNK 1 the layers with the highest totals tend also to have the greatest variety of species. It may, alternatively, reflect changes in the vegetation; but by and large the presence of the species mentioned suggests an environment different from that around BNK 1.

The faunal list from Wilton (J. Deacon 1972, table 4) reveals the exploitation of a much smaller range than the sites hitherto discussed. Excluding the micromammals, there are 2–7 taxa in the individual layers, compared with 26 in BNK 1 layer or 23 in layer 5, and a total of 15 taxa are represented, compared with 36 at BNK 1, 32 at Die Kelders, 40 at Nelson Bay Cave and 32 at Melkhoutboom.

The Wilton faunal sample does not show a predominance of the very small size class. The ranking of the size classes, from highest to lowest, is: small, small medium, very small, and large medium. The large and very large size classes are not represented, but otherwise the predominance of the smaller size classes is similar to the pattern for the upper layers of BNK 1, the Holocene deposits at Die Kelders, and the 'Wilton' deposits at Nelson Bay Cave and Melkhoutboom. The Wilton faunal sample consists principally of small and small medium bovids, in terms of Klein's and Brain's size classes and as such is markedly different from that of the upper layers of BNK 1 in which, although small bovids are the largest individual bovid size class, there is a higher frequency of large medium and large bovids than of small medium, except in layer 1; and the very small non-bovid species are also more common at BNK 1 than at Wilton.

The preliminary analysis of the fauna from Boomplaas (Klein 1978b, table 1) suggests much the same range of species as is present in the BNK 1 sample. Among the more marked differences between the two sites is the persistence at Boomplaas of *Equus zebra/quagga* through to the terminal deposit while at BNK 1 *E. cf. quagga* is not present after layer 9, some 4 000 years earlier. *Potamochoerus porcus* and/or Suidae-general occur only sporadically at Boomplaas until the lower 'herder' levels while at BNK 1 they are present throughout the sequence, except in layer 11. *Damaliscus dorcas/niro* is present at Boomplaas only in the lowest but one of the 'Albany' layers, while at BNK 1 *D. dorcas* is absent only after layer 11, perhaps 2 000–3 000 years later than at Boomplaas.

In the 'Robberg' levels at Boomplaas large medium bovids are the most common of the bovid size classes, followed by large, and with small and small medium ranking equal third. In the remaining levels small bovids are most

common, but in the 'Albany' large medium rank second and small medium third, while in the 'Wilton' and 'Herder' levels this order is reversed. The Boomplaas data seem to suggest that the introduction of domestic sheep into the area affected the hunting, not of small bovids as might be expected but of large medium and large ones, although these are not common, even in the preceding 'Wilton' levels. BNK 1 layer 1 contains a sub-unit without *Ovis aries* but the pattern for this layer, compared with the underlying layers, is for a decline in the frequency of small and large medium bovids while the frequency of small medium, in which *Ovis aries* is included, and large both increase.

When all species are considered, the Boomplaas sample indicates changes in the three top ranking size class frequencies:

'Robberg': large medium, large, very small;

'Albany': small, large medium, small medium;

'Wilton': very small, small, small medium;

'Herder': small, small medium, very small.

This shows that while the pattern of ranking for the 'Wilton' of Boomplaas is identical to that of the upper layers of BNK 1 there are differences between the two sites where the lower layers are concerned, since the ranking for the lower layers of BNK 1 is large medium, very small, and small.

Klein (1978a, table 1) has also analysed the fauna from Buffelskloof. Although the sample is small, maximally 146 individual mammals in twenty-five taxa, the pattern of ranking of the size classes in the 'Wilton' levels is much the same as at Boomplaas and BNK 1, although there is a relatively higher frequency of large medium animals. These account for 16,0 per cent of the 'Wilton' total at Buffelskloof, 9,0 per cent at Boomplaas and only 4,4 per cent of the total for the upper layers at BNK 1. This gain is largely at the expense of the very small size class, which is some 12,0 per cent higher at Boomplaas and BNK 1 than it is at Buffelskloof.

As is the case in the lower layers of BNK 1 the large medium size class ranks highest in the 'Albany' layers at Buffelskloof. However, while at Buffelskloof the very small size class ranks second and the small third, in the lower layers of BNK 1 the second and third rankings vary, from large medium generally second in layers 19-16 and small or small medium third, while in layers 15-11 the second and third rankings are generally filled from the three smaller size classes.

In terms of relative chronology the fauna from Elands Bay Cave (Parkington 1980b, table 1), also analysed by Klein, may be divided into two units, layers 16-10 relating to BNK 1 layers 19-14/13, and layers 9-1 relating to BNK 1 layers 4/3-1. The Elands Bay Cave faunal list does not include *Arctocephalus pusillus*, which is listed separately (table 3) but is included in the comparisons that follow.

The three highest ranking size class frequencies for Elands Bay Cave are:

layers 16-10: small, very small, small medium;

layers 9-1: small medium, very small, small.

In the selected BNK 1 layers the rankings are:

- layers 19–13: large medium, small medium, small;
- layers 4–1: small, small medium, very small.

This shows that while the only difference in the samples from the upper layers of both sites is the order in which the three smaller size classes rank, and the same is also true for both groups of the Elands Bay Cave layers, whereas in the lower layers of BNK 1 the large medium size class is highest ranked but does not appear in the Elands Bay Cave top rankings. There is, in fact, less difference between the samples from the upper and lower layers of Elands Bay Cave than between those of BNK 1.

The three smaller size classes account for 86,5 per cent of the total for the lower layers at Elands Bay Cave but only 42,9 per cent of the total for BNK 1 layers 19–13. The large medium size class accounts for only 3,8 per cent of the total for the lower layers at Elands Bay Cave but 37,5 per cent of the total for those at BNK 1. In the upper layers the three smaller size classes account for 91,4 per cent of the Elands Bay Cave total and 79,6 per cent of the BNK 1 total.

Raphicerus spp. are the most common mammals at Elands Bay Cave, followed by *Bathyergus suillus* and *Arctocephalus pusillus*. While *Raphicerus melanotis* is the more common of the two species at BNK 1 and *R. campestris* apparently only a later arrival some 4 000 years ago, *R. melanotis* is the more common species in the lower layers of Elands Bay Cave, but after the hiatus, i.e. from about 4 000 years ago, *R. campestris* is more common. *Bathyergus suillus* is more common in the lower layers of Elands Bay Cave than in the upper, with 72 per cent of the site total in layers 14–10 alone, while in the BNK 1 sample almost 82 per cent of the site total comes from layers 9–1. Elands Bay Cave layer 12 yielded half the site total of *Arctocephalus pusillus* but apart from this frequencies in the upper layers are higher than in the lower. This species does not, however, assume the importance at Elands Bay Cave that it does in the 'Albany' and 'Wilton' deposits at Nelson Bay Cave.

DISCUSSION

On the basis of the radiocarbon dates for BNK 1, layer 19 and probably some of the overlying layers, up to but not including layer 14, fall within the conventional dating of the terminal Pleistocene, while the remaining layers are within the time range of the Holocene. The restriction of the single *Equus* cf. *capensis* to layer 19 is thus not unexpected since this animal is listed among those considered to have become extinct by the end of the Pleistocene (Klein 1974, table 3; 1980: 265). At the other end of the chronological scale, the restriction of *Ovis aries* to layer 1 is likewise not surprising, since domestic sheep have not been recorded from archaeological deposits in the southern Cape before about 2 000 B.P. (Schweitzer & Scott 1973, G. Avery 1974, H. J. Deacon *et al.* 1978, Schweitzer 1979). Sheep remains found in the lowest sub-unit of layer 1 are considered to be intrusive and the date of $1\ 880 \pm 50$

years B.P. probably marks the earliest occurrence of these animals in the BNK 1 deposits.

Although the evidence of a single occurrence cannot be regarded as conclusive, the restriction of *Phacochoerus aethiopicus* to layer 13 may be related to the disappearance from the deposits of *Damaliscus dorcas* after layer 11 and *Equus* cf. *quagga* after layer 9. These three species are characterized as having a preference for open country, grassland in the case of the last two (Dorst & Dandelot 1972: 173, 228, 164 (for *Equus burchelli*); Klein 1974: 273–276). Their absence from the upper layers may thus reflect a change in the vegetation of the area by about 6 000 B.P. Against this, however, must be considered the identification of *Damaliscus dorcas* in the late Holocene deposits at Die Kelders and the continued presence in the BNK 1 deposits, albeit in reduced frequencies, up to layer 1 of the alcelaphine *Connochaetes/Alcelaphus* and of *Hippotragus* spp. up to layer 4. These bovids are all characterized as gregarious grazers with a preference for open or lightly wooded grassland, or mixed bush and grassland in the case of one of the hippotragines (*H. niger*) (Dorst & Dandelot 1972: 230–232, 218–222, 204–206). *Hippotragus leucophaeus* and *Alcelaphus buselaphus* have been tentatively identified at Die Kelders (Schweitzer 1979, table 27) and the problem therefore seems one of establishing whether there has been a major vegetational change in the general Die Kelders–BNK 1 area in the past 2 000 years or so (Avery's (1979) vegetation unit 1?) or where the prehistoric hunters hunted these grazers.

The apparent absence of *Raphicerus campestris* before layer 6, i.e. about 4 000 years ago, is of interest although it is not inconceivable that this species may be represented in the otherwise unidentifiable *Raphicerus* spp. in the underlying layers, since only four of the forty-one individuals in these layers could be identified as to species. Pienaar (1974: 187) lists *R. campestris* as one of the three most successful antelope species in southern Africa, 'being able to exploit a wide range of ecological situations, even those that have become severely degraded by the activities of man'. Tinley (1969, fig. 3) shows *R. campestris* as occupying a much wider range of habitats than *R. melanotis*, and Dorst & Dandelot (1972: 269, 275) show *R. campestris* as endemic to virtually the whole of southern Africa, while *R. melanotis* is restricted to the southern Cape.

Klein (1976b: 171) has noted that in modern populations *R. campestris* is more common than *R. melanotis* in the western part of the southern Cape (St. Helena Bay to False Bay), while in the southern and eastern parts (False Bay to Cape St. Francis) *R. melanotis* is the more common species, and he has elsewhere observed (Klein 1972a: 196) that *R. melanotis* is the only species now to be found in the vicinity of Nelson Bay Cave. On the basis of archaeological data, Klein (1976b: 181) has postulated that the present distribution and relative frequencies of the two species had become established at least by the late Holocene. The evidence from Elands Bay Cave indicates that both species were present in the area by the end of the Pleistocene and that by about 3 500

years ago *R. campestris* had become the more common species, while the evidence from BNK 1 suggests that by about 4 000 years ago *R. campestris* may have moved into an area apparently previously occupied only by *R. melanotis*. The two species have somewhat different habitat preferences (Dorst & Dandelot 1972: 264, 266) and the indications from Elands Bay Cave and BNK 1 are therefore that by about 4 000 years ago an environmental change had taken place in the vicinity of both sites, and consequently possibly also elsewhere, that created the more open habitat preferred by *R. campestris*. Whether this change was the result of a degree of aridification or of human activity, e.g. veld-burning, or a combination of these and perhaps other factors, is a matter that cannot at present be determined.

That most of the species listed in Table 15 are present throughout the BNK 1 sequence suggests, in view of the changes in their relative frequencies, a change in the balance of the methods of procurement rather than in the methods themselves. There are few tools in the assemblage, whether of stone or bone, that can be associated specifically with hunting, and the restriction of bone points and, probably, linkshafts to layer 6 and above is not consistent with the changes in the faunal patterns indicated in Table 15 and Figure 39. Similarly, changes in the relative frequencies of the stone artefacts, especially backed pieces, do not correspond to the changes in the faunal patterns. Most of the smaller animals are crepuscular or nocturnal, and non-gregarious, and it is possible that these animals were caught in traps or snares. The larger animals would perhaps have been hunted with bow or spear or, in the case of the very large animals, trapped in pitfalls. The digging of pitfalls, and possibly also the hunting of the larger animals, would have required communal effort while the setting of traps and snares would not, and it may therefore be suggested that the changes in the faunal patterns indicate changes in social patterns, in that they indicate an increase in individualistic behaviour during the Holocene. Whether this change in social behaviour can confidently be linked to changes in the balance of resources as a result of environmental change is a matter that must await external evidence in the form of independently derived palaeo-environmental data.

Because *Ovis aries* is restricted to layer 1 at BNK 1 and frequencies in the individual sub-units of this layer are so low, it is not possible to assess the effect of the introduction of domestic animals into the area on the procurement patterns of the cave occupants. The 2,3 per cent increase in the relative frequency of animals in the small medium size class in layer 1, compared with the frequencies for layers 2 and 3, cannot be considered significant, and perhaps the most that can be inferred from the BNK 1 data in this respect is that after about 1 900 B.P. an animal that was possibly more easily procured was added to the range of those already available.

When the data for the BNK 1 mammal fauna are compared with those for other sites in the southern and western Cape they show quite marked differences in the nature and chronology of the patterns of change, except in the

later Holocene, when there appears to have been a common emphasis on the procurement of a greater number of smaller animals than was previously the case. The probable explanation of these differences is that the environments of the various sites have never been precisely similar. The ecological balance in the various areas would therefore have been different and, even given an overall climatic change, the rate and nature of the effects of that change would have varied from region to region. The reason for the general similarity of procurement patterns in the later Holocene cannot, however, be ascribed to climatic change inducing a general homogeneity in the ecology of the regions in which the various sites are located. It seems that there must be an overriding factor that is probably cultural, possibly demographic, but such an assumption cannot be tested until a greater body of information is available, from more than single-site observations, on patterns of human distribution and land-use.

SHELLFISH

The differences between the shellfish samples from Die Kelders (Schweitzer 1979: 186–194) and BNK 1 are marked, although the two sites are only some 10 km apart. The chronology of the Holocene deposits at Die Kelders is short and approximates only that of the last sub-unit but one from the bottom of BNK 1 layer 1, so that comparability is somewhat limited. However, even when the layer 1 sample is compared with that from Die Kelders the difference in the relative frequencies of the genera is great, as Table 25 shows.

TABLE 25

Shellfish: ranked frequencies of genera from BNK 1 layer 1 and Die Kelders.

BNK 1	%	DK 1	%
<i>Turbo</i>	35,0	<i>Choromytilus-Perna</i>	66,9
<i>Oxyste</i>	24,5	<i>Burnupena</i>	17,3
<i>Choromytilus-Perna</i>	17,9	<i>Patella</i>	6,3
<i>Burnupena</i>	11,4	<i>Oxyste</i>	6,1
<i>Patella</i>	5,2	<i>Turbo</i>	2,1
<i>Dinoplax</i>	3,7	<i>Haliotis</i>	0,8
<i>Donax</i>	1,9	<i>Donax</i>	0,3
<i>Haliotis</i>	0,3	<i>Bullia</i>	0,2
		<i>Dinoplax</i>	0,04

(Die Kelders (DK 1) details after Schweitzer 1979, table 19.)

Human preferences apart, the most reasonable explanation of these differences seems to be the differing littoral topography which, in the vicinity of Die Kelders, appears to offer a more favourable habitat for *Choromytilus meridionalis* than does the coast east of Danger Point. With the exception of *Bullia*, which scavenges in the surf zone of sandy beaches, all the gastropods listed in Tables 18 and 25 inhabit rocky crevices or pools, many of them in the lower tidal zones (Day 1969), and it seems likely that the steeper rocky shores in the

vicinity of Die Kelders would have made these shellfish less accessible than on the coast east of Danger Point, which is less steep and contains gullies and tidal pools (cf. Fig. 5).

Although Day (1969: 1) states that Walker Bay is an area of warm water in which there are more south coast species (than those of the colder waters of the west coast), the composition of the *Patella* species from Die Kelders (Schweitzer 1979, table 21) is more representative of the west coast distribution, while that from BNK 1 is closer to the south coast distribution although containing aspects of the cold-water distribution (cf. Branch 1971, figs 3–5); (see also Schweitzer 1979: 111). *P. granatina* dominates the Die Kelders *Patella* sample and the *P. granatina*:*P. oculus* ratio is 6:1. The BNK 1 layer 1 *Patella* sample is dominated by *P. longicosta*, which is absent from the Die Kelders sample, and the *P. granatina*:*P. oculus* ratio is less than 1:2.

G. Avery (1976: 125–126), who has studied shell middens at Pearly Beach, south-east of BNK 1, and at Hawston to the north-west, has preferred to characterize middens on the basis of the dominant shellfish represented in terms of 'meatmass' rather than simple numerical frequency. Not surprisingly, the middens are consequently primarily characterized as *Haliotis* or *Turbo* middens, or a combination of, or variations on, these. *Haliotis midae* and *Turbo sarmaticus* are among the largest shellfish to be found on the South African coast and have an average flesh mass 4–60 times greater than that of genera such as *Oxystele* and most of the *Patella* species (cf. G. Avery 1976, table 5). Additionally, however, Avery (1974: 112; 1976: 111 ff.) has characterized some of the middens as *Oxystele*–*Patella*–*Turbo* which apparently reflects the numerical ranking of the species rather than 'meatmass' dominance since *Haliotis* and/or *Turbo* are always the dominant genera in terms of flesh mass (cf. G. Avery 1976, table 7).

With the exception of layer 3, in which *Oxystele* is numerically dominant but exceeds *Turbo sarmaticus* by a ratio of less than 2:1, all the shell samples in the upper layers of BNK 1 can be considered as *Turbo* dominated. This Avery (1976, table 7) found to be unequivocally the case in only one of the eight sites he studied, although one (PB 1) showed a change from *Turbo* domination in the lower part of the midden to *Haliotis* domination in the upper.

Although no quantitative analyses were carried out of the shellfish from Oakhurst (the material was, in fact, not taken from the site), Goodwin (1938: 322–323) mentioned that the 'Smithfield B' deposit contained mainly oyster and razor shells (*Ostrea* and *Solen* spp.), while in the 'Smithfield C' deposits a change was noted from *Donax serra* in the lower levels to *Choromytilus meridionalis* in the upper (but see also p. 314, where Goodwin remarks that although there were *C. meridionalis* shells in the 36–45 inch (91–114 cm) level, they form a negligible part of the whole deposit'). With regard to the 'Wilton' Goodwin (1938: 323) observed only that 'throughout the Developed Wilton the basis of subsistence is mainly shellfish, fish, and animals'. Unless a

ranking of the frequency with which the three taxa occurred is implied (and the omission of plant foods from the list may or may not have any significance), the observation has little value. Elsewhere, Goodwin (1938: 305) lists the molluscs found in the upper 9 inches (23 cm) of the deposit. These are not quantified, and the most that can be said is that the list contains most of the genera found at BNK 1. *Donax serra* is numerically dominant in BNK 1 layers 14–11, which may be relatable to the 'Smithfield' deposits at Oakhurst, but the frequencies of all the genera in the lower BNK 1 layers are too low for this to be considered meaningful. In layer 10 *Turbo sarmaticus* assumes its dominant role, suggesting a marked difference from the Oakhurst 'Wilton'.

Klein (1972a, fig. 4) indicates that at Nelson Bay Cave marine shell was not found in the deposits below the base of the 'Albany', but J. Deacon (1978: 89) has reported its presence in small quantities in layer BSL, the uppermost of the 'Robberg' layers, from which frequencies increase through time. Although this is similar to the pattern at BNK 1, there is a great difference between the times when this occurred at the two sites. Nelson Bay Cave layer BSL is dated at $11\,950 \pm 150$ years B.P. (Klein 1972a: 202), which approximates the date of BNK 1 layer 19 and, while marine shell is present in layer 19 and thereafter, it is only in layer 10, some 5 500 years later, that the occurrence of marine shell can be said to indicate an increasingly important food resource.

The Nelson Bay Cave shellfish sample is dominated by *Perna perna* (*Choromytilus meridionalis* in the lower layers), with *Patella* ranking second. This mussel-dominated sample is more like that of Die Kelders than that of BNK 1, although at Die Kelders *Patella* spp. rank after *Choromytilus*–*Perna* and *Burnupena* spp.

J. Deacon (1979: 78) reports that while there was no quantification of marine shell from the Matjes River Shelter, one of the largest shell midden deposits in the southern Cape, a change was noted, from *Donax serra* being more common in layers D and C to *Choromytilus meridionalis* in layers B and A. The top of layer C is dated to $5\,400 \pm 250$ years B.P. and the B–A interface to $3\,555 \pm 35$ years B.P. (J. Deacon 1979: 74) so that the Matjes River deposits probably cover the same span of time as the upper layers of BNK 1, although Sampson (1974: 263–269) has indicated that layer D, at least, is 'pre-Wilton' and has included the lithic component in his 'Oakhurst industry'. The sparse information available suggests that the shellfish component of Matjes River Shelter may be more similar to that of Die Kelders, Nelson Bay Cave, and Oakhurst than to that of BNK 1.

Voigt (1975, table 1) has shown diagrammatically the shellfish frequencies for the 'pre-pottery L.S.A.' and 'pottery L.S.A.' levels of the Klasies River Mouth cave sites. Although the sites have a record of shellfish exploitation extending back to the Middle Stone Age, the levels mentioned are the only ones chronologically comparable with BNK 1. These levels are approximately dated to between 4 800–2 200 B.P. (Singer & Wymer 1969; Butzer 1978: 146–147) and are thus contemporary with that part of the BNK 1 deposit

from the lower part of layer 1 to somewhere between layers 5 and 9. Although it is not clear on what evidence the superpositioning of the sequences in the various caves in Voigt's figure 1 is based, the indications are that the L.S.A. levels are generally dominated by *Patella*, principally *P. longicosta*, but there is a marked increase in the frequency of *Oxystele* in the uppermost, pottery-bearing layers of Cave 1D. *Patella longicosta* is always the predominant *Patella* species in the upper layers of BNK 1, but the genus is always subordinate to *Turbo* and, from layer 4 up, *Oxystele*. In terms of flesh mass, however, *Turbo sarmaticus* is always the dominant species in the Klasies River Mouth L.S.A. levels, as it is in the relevant BNK 1 layers. In general, the Klasies River Mouth L.S.A. shellfish samples show a greater similarity to those from the upper layers of BNK 1 than do either of these to the samples from the other sites discussed.

The Bonteberg Shelter on the west coast of the Cape Peninsula (Fig. 1) represents the earliest local attempt at systematic analysis and characterization of shell midden deposits (Maggs & Speed 1967). The deposits from this shelter were dated from marine shell samples to about 4 500–2 000 B.P. (Grindley *et al.* 1970) but since radiocarbon dates from marine shell tend to be older than those from charcoal (Klein 1972a: 202–203; Vogel & Visser (1981: 43) suggest about 400 years), the Bonteberg deposits may be considered approximately coeval with those from BNK 1 layer 5 to the lower part of layer 1.

The Bonteberg shellfish sample, although small, is essentially dominated by *Patella* spp. but shows a shift in the top layer, 2b, towards *Oxystele* and *Burnupena*. The totals for *Patella granatina* and *P. oculus* have been combined but these are by far the most common species in the samples (69–84% of the layer totals for *Patella*) suggesting that a higher littoral zone was being exploited than at BNK 1, where *P. longicosta* is the dominant species (cf. Branch 1971, figs 3–4). *Choromytilus meridionalis* accounts for about 2–10 per cent of layer totals, but increases almost threefold in layer 2b, a situation similar to that in BNK 1 layer 1.

Buchanan (1977) carried out a rescue operation in a small shelter at Hout Bay (Fig. 1). Dates of $1\,840 \pm 50$ years B.P. for the top of the bottom layer and $1\,460 \pm 50$ years B.P. for the middle of the top layer (Buchanan 1977: 14) suggest that the whole of the occupation of the site falls within the time range of BNK 1 layer 1.

As Buchanan's table 3 indicates, *Choromytilus meridionalis* is dominant in each of the five layers, with frequencies of 45–56 per cent of individual layer totals. *Patella* spp. (19–24%) rank second in layers 5, 4 and 2, while *Burnupena* frequencies (16–26%) rank second in layers 3 and 1. *Patella granatina* is the most common *Patella* species, followed by *P. granularis* in layers 5–3, and *P. cochlear* in layers 2 and 1. The species representation suggests exploitation of littoral zones higher than those indicated by the BNK 1 sample, and not unlike those indicated by the Bonteberg sample. Deeper water species such as *Turbo sarmaticus*, *Haliotis midae*, *Patella argenvillei*, and *Argobuccinum argus* are rare in, or absent from, the layer samples.

Buchanan's table 5 gives means and standard deviations for lengths of *Patella granatina*, *P. granularis* and *P. cochlear* from the site. Sample sizes are small and in most cases the standard deviation exceeds the difference between the highest and lowest means. It would seem unwise, in the circumstances, to use such data as the basis for speculations regarding the fluctuating mean lengths as being indicative of the 'farming down' of the local shellfish populations through human predation.

Buchanan's table 6 shows that the mean lengths of *Patella granatina* and *P. granularis* from archaeological sites are 25–36 per cent smaller than those of modern samples. This has led Buchanan (1977: 28) to support the suggestion by Parkington (1976: 134–135) that intensive predation reduced the average lifespan and thus the average size of the shellfish without, however, endangering species survival. Buchanan continues by observing that since the size reduction is evident in the first occupation layer 'the predation/survival equilibrium must have been reached prior to the first occupation'.

Although the Hout Bay Shelter samples are chronologically comparable with those from only some of the sub-units of BNK 1 layer 1, the fact that there is very little change in the mean length of most *Patella* species from BNK 1 layer 9 up can similarly be used to suggest that a 'predation: survival equilibrium' had been reached in the BNK area from the earliest stages of intensive shellfish collecting. This in turn prompts the hypothesis that the marked increase in shellfish representation in the upper layers of BNK 1 is relevant to the site only and that, in fact, intensive predation of the local shellfish populations had been in progress prior to about 6 500 B.P. but that the bulk of the 'catch' was not being brought back to the site. Support for such a hypothesis would be provided by the discovery of shell middens or other sites in the area with high frequencies of marine shell that could be dated to earlier than 6 500 B.P., but such sites have not yet been found. A marine transgression commencing at about 6 500 B.P. (see p. 10) could have destroyed earlier coastal middens but ought to have left others on the edge of the then coastline(s), which might have been covered by the seaward advance of the dunes and vegetation during the subsequent regression, but it seems unlikely that evidence of these would not have been found before now.

Robertshaw (1977, 1978, 1979) excavated shell middens at Paternoster, Stofbergfontein, and Duiker Eiland on the Cape west coast (Fig. 1). The dates obtained for the sites are all within the range of BNK 1 layer 1. While there was a marked increase in the frequency of *Choromytilus meridionalis* in the uppermost layer of an otherwise *Patella*-dominated deposit at Paternoster (Robertshaw 1977, table 4), at Stofbergfontein the main unit was dominated by *Patella* species but in the subsidiary unit *Choromytilus* was dominant (Robertshaw 1978, table 4), and at Duiker Eiland *Patella* was always dominant (Robertshaw 1979, table 5).

In the sample from Paternoster layer 1 the mean lengths of *Patella granularis* and *P. granatina* are 2–3 mm and 7–11 mm greater than those of the

underlying layers (Robertshaw 1977, table 5). From this, Robertshaw (pp. 67–68) has reasoned that the increase in the sizes of the two species in layer 1 might have resulted from a lower rate of predation of *Patella* species consequent on the increased exploitation of *Choromytilus meridionalis* in this layer. The two units of the Stofbergfontein deposit could not be related stratigraphically (Robertshaw 1978: 142) so that the differences in the mean lengths of the two *Patella* species (less than 1 mm and 3,5 mm respectively) cannot be interpreted. For the three layers of the Duiker Eiland sample (Robertshaw 1979, table 6) *Patella granularis* has a maximum variation in mean length of 2 mm and *P. granatina* of just over 4 mm. Although the mean lengths for layers 1 and 2 are about 2–4 mm higher than those for layer 3 the small variation suggests little change in the structure of the populations being exploited, and the same is true for at least *P. granularis* in the Paternoster samples.

Robertshaw (1977: 67, 1979: 9) has suggested that the mean lengths of these two species are small when compared with modern population data given by Branch (1974) and Buchanan *et al.* (1978), and elsewhere (Robertshaw 1978: 143) he observes that ‘the mean sizes . . . seem to reflect a rate of predation high enough to have had the effect of farming down the local populations of these species . . .’. It must be pointed out, however, that Branch (1974a or 1974b) does not give mean lengths for the modern *Patella* populations he studied but provides a series of histograms showing the frequency distribution of the population over its total size and age range. Calculation of the mean length of each of the two species under discussion from Branch’s histograms (Branch 1974b, figs 14–15, see also Fig. 42 herein *re P. granatina*) yields a mean length for *P. granularis* of 13,9 mm for the whole population or 26,1 mm for those individuals 20 mm or longer, and for *P. granatina* 37,0 mm for the whole population or 44,4 mm for the larger individuals. The higher mean for *P. granularis* is in each case *lower* than those for the archaeological samples: 10–13 mm in the case of Paternoster, 14–15 mm in the case of Stofbergfontein, and 10–12 mm in the case of Duiker Eiland. Where *P. granatina* is concerned, the mean for the larger modern population is again *lower* than those of the archaeological samples: 2–13 mm lower than Paternoster, 9–13 mm lower than Stofbergfontein, and 10–13 mm lower than Duiker Eiland. In the BNK 1 *P. granatina* samples it is only that from layer 3 that approaches the mean length of the larger modern population, the means from the other layers being 5–10 mm higher (Fig. 42).

The mean lengths of the modern samples given by Buchanan *et al.* (1978, fig. 3) are stated to be those of the *largest available* individuals that could be measured in ten minutes, and the same is probably true of the samples measured by Olivier (1977, cited by Buchanan 1977, table 6). The motivation for these sampling procedures is (partly) understandable but they do not provide an accurate reflection of the total population structure and therefore do not, any more than Branch’s data, support Robertshaw’s suggestion that the

mean lengths of the archaeological samples are small when compared with those of modern populations, nor can they be said to indicate 'farming down'. What they do indicate, rather, is that prehistoric shellfish collectors had a preference for the larger-sized individuals but that they were not averse to taking individuals of whatever size were available and, presumably, that they considered worth the effort of prising off the rocks.

The available data on shellfish from Elands Bay Cave (Parkington 1979, table 5) are sparse, but indicate that while *Patella* spp. make up the bulk of the shellfish in most of the lower layers there was a marked increase in the frequency of *Choromytilus meridionalis* in the layers after the hiatus, also of 'whelks' in layers 1 and 2. Layer 12 is anomalous, as in several other instances previously mentioned, in having a higher frequency of whelks than of mussels, while in layer 1 it appears that there was a more equal distribution of the three main taxa. Although in the BNK 1 sample *Turbo sarmaticus* remains the dominant species in layer 1, there is a marked increase in the frequencies of *Choromytilus meridionalis*, *Oxysteles sinensis*, and *Burnupena* spp. relative to the lower layers, and this parallels to a certain extent the situation at Elands Bay Cave.

DISCUSSION

Although it is evident from Table 18 that shellfish were brought to BNK 1 from the initial occupation of the site some 12 500 years ago, it is not until about 6 000 years later that there is any clear evidence of the exploitation of shellfish as an increasingly important food resource. That the systematic exploitation of shellfish appears to have begun towards the end of the Pleistocene at sites like Nelson Bay Cave and Elands Bay Cave may be related to the increasing proximity of the sea to those sites from this time on. It does not seem, however, that this explanation can be applied to the apparent lateness with which this practice started at BNK 1 since, as shown during the discussion of the topography of the BNK area, the shore is not likely to have been more than 10 km from the cave at any time during the occupation of the site. Possible explanations are that prior to about 6 500 B.P. the availability of land game was sufficient for the human population of the area without the need to exploit possibly less favoured resources; or that from about 6 500 B.P. changes in demographic patterns resulted in the more frequent use of the cave, either as a base for stays of longer duration or as a transit camp en route from this part of the coast. However, although the lack of precise data leaves much to be desired, the indications from sites such as Oakhurst and Matjes River suggest that there was a general increase in the exploitation of shellfish at about the same time as this occurred at BNK 1.

The frequency with which the various species are represented at the different sites is undoubtedly primarily related to the ecology of the littoral zones in the vicinity of these sites, although factors such as accessibility and preference cannot be ignored. The relative scarcity of *Haliotis*, particularly

H. midae, at BNK 1 and Die Kelders is not easy to explain. This shellfish has the highest ratio of flesh mass to total mass of all the genera represented at these sites and occupies the same littoral zone as *Turbo sarmaticus*, and there is abundant evidence all along the coast from Pearly Beach to Die Kelders that *Haliotis midae* was heavily exploited. The fact that there are shells in the deposit at BNK 1 tends to diminish the possibility that the flesh was removed and the shells left at the coast. A. B. Smith (1981 pers. comm.) has suggested that there may be a temporal factor involved, but this could only be tested by obtaining a good range of dates from concentrations of *H. midae*.

The low frequency of *Donax serra* is also not readily explained. The white mussel is fairly easily obtainable by digging in the sand at low tide and has a greater flesh mass in proportion to its size than either the black mussel *Choromytilus meridionalis* or the brown, *Perna perna*. These species are, however, also not well represented in the BNK 1 samples, and it may simply be that along the coast east of Danger Point the collecting of *Turbo sarmaticus* was more profitable, and *Choromytilus-Perna* in the Die Kelders area.

The increase in the frequencies of *Oxystele sinensis* and *Burnupena* spp. may be seen as reflecting the need to augment the food supply as increasing demands on the larger species thinned them out, although there is not the proportionate increase in the frequencies of these smaller species that might be expected in such a circumstance. It seems, though, more than mere coincidence that similar patterns are evident in the shellfish samples from sites as far afield from BNK 1 as Klasies River Mouth and Elands Bay Cave. As indicated in the discussion of *Patella* lengths, the archaeological data do not appear to lend themselves to the deriving of inferences regarding the effects of human predation on the ecology of local shellfish populations or regarding changes in past sea temperatures although the potential, based on a more systematic approach on an interdisciplinary level, should not be underestimated.

FISH

As at BNK 1, *Pachymetopon blochii* is the most commonly represented fish at Die Kelders (Schweitzer 1979, table 23) but whereas at BNK 1 it accounts for only 37,4 per cent of the site total or 33,3 per cent of the layer 1 total, it accounts for 96,4 per cent of the Die Kelders total. *Lithognathus lithognathus* and *Rhabdosargus* spp. are next in order of frequency but their ranking is reversed in the Die Kelders sample and their frequencies much lower than at BNK 1. The differing frequencies probably reflect the differing off-shore environments in the vicinity of the two sites, with the coastline near BNK 1 offering a wider range of habitats than that around Die Kelders. The Die Kelders sample, however, contains minimally seven genera, only two less than the BNK 1 sample.

Goodwin (1938: 323) noted that at Oakhurst 'at the Wilton level begins a marked increase in fish-bone, suggesting that efficient means of catching fish had been evolved'. If the date of $7\,910 \pm 70$ years B.P. (Pta-377) obtained from

just above the 'carbon floor' is 'consistent with the dating of the base of the Wilton at other Cape sites' (J. Deacon 1979: 36), then the effective exploitation of fish began at Oakhurst at a time closer to the date of BNK 1 layer 12, some 1 500 years earlier than layer 9, in which the relatively large increase in fish remains first becomes evident.

Poggenpoel (1979) has recently re-analysed the fish remains from the 1964–71 excavations at Nelson Bay Cave by Inskeep and Klein. The five upper layers excavated by Inskeep that provided the data for Poggenpoel's table 2 are all dated to less than 3 000 B.P. (Inskeep *in* J. Deacon 1979: 64), while those excavated by Klein that provided the data for Poggenpoel's table 3 are dated to between about 5 000 to 18 000 B.P. (Klein 1972a: 202; J. Deacon 1978: 84, fig. 2). The upper group of layers all fall within the time range of BNK 1 layer 1 and the rest, up to layer BSL, are within the range of dates for BNK 1 layers 5–19.

Perhaps the major difference between the two sites where fish remains are concerned is in frequencies: over 15 000 individuals have been identified from Nelson Bay Cave as against only 265 from BNK 1. Fish remains first appear in the Nelson Bay Cave sequence in layer BSL, the uppermost of the 'Robberg' units. The 'Robberg' yielded 0,1 per cent of the site total, the 'Albany' about 9,0 per cent and the remaining 91,0 per cent came from the 'Wilton'. BNK 1 layer 19 yielded 0,4 per cent of the site total (there were no fish remains in layer 18), layers 17–10 4,5 per cent, and layers 9–1 the remaining 95,0 per cent. Although there were more fish in the 'Albany' layers than in BNK 1 layers 17–10 the chronological distribution at both sites is similar.

Another major difference between the two sites is in the number of genera represented. In the BNK 1 sample only 9 genera have been identified, while in the Nelson Bay Cave sample there are at least 17, taking the Clinidae/Blenniidae to represent only one genus each although they are actually families containing 16 and 7 genera respectively (Smith 1949: 342–346, 350–358). At BNK 1 the number of genera ranges from 1 to 3 per layer in the lower layers and 3 to 7 in the upper, indicating a broadening of the resource base. At Nelson Bay Cave the number of genera increases from 3 in the 'Robberg' to 3–12 in the 'Albany' and 10–17 in the 'Wilton'. In passing, it should be noted that layer Rice B (Poggenpoel 1979) or RB (J. Deacon 1978) contains 12 genera and is thus more typical of the 'Wilton' layers than of the 'Albany' in which Deacon has included it, since the other layers in this unit contain only 3–7 genera per layer.

A further point of difference between the two sites is that while BNK 1 shows a clear pattern of increase only from layer 10 to layer 5, after which frequencies decrease until the end of the sequence, the Nelson Bay Cave sample shows a broad pattern of increase throughout the sequence. The lower 'Wilton' layers contain more than twice as many individuals as the 'Albany' and the upper 'Wilton' more than three times as many as the lower 'Wilton' and almost eight times as many as the 'Albany'. The possibility of different

excavated volumes cannot be discounted but it seems likely that the broad pattern of increase would override the quantitative bias caused by these.

Also, whereas at BNK 1, possibly because of the low layer frequencies, there is no discernible change in the relative frequencies of the principal genera, changes are evident throughout the Nelson Bay Cave sequence. *Sparodon durbanensis* is generally most common in the 'Albany', *Diplodus sargus* in the lower 'Wilton' and Clinidae/Blenniidae in the upper.

The indications are, therefore, that at Nelson Bay Cave fishing became increasingly important through time and although frequencies relative to excavated volume (ADs) would provide a more accurate picture of the importance of fish in the dietary economy of the cave inhabitants, on the present evidence it seems that fishing was a major industry for the people of Nelson Bay Cave, which does not seem to have been the case for the people of BNK 1.

Poggenpoel's paper also contains an analysis of the fish remains from Elands Bay Cave. These first appear in the second layer (19), estimated to date at some 15 000–17 000 years B.P. Poggenpoel's table 4 gives the total number of identified individuals as 1 306, almost five times as many as the total from BNK 1. Elands Bay Cave layer 12 is again anomalous in that it contained 63 per cent of the site total, but otherwise individual layer frequencies are low, ranging from 0,8 to 5,4 per cent of the site total (with 20 layers the mean frequency based on an even distribution would be 5%). Beyond the fact the frequencies in the layers above layer 15 are higher than those in the layers below, there is no evident pattern of increase through time the way there is at Nelson Bay Cave. Elands Bay Cave layer 15 falls within the time range of BNK 1 layers 19–15.

Lithognathus lithognathus is generally the most common species in the Elands Bay Cave sample, followed by *Rhabdosargus globiceps* but in layer 13 *Liza richardsoni* accounts for sixty of the seventy-one individuals, and this is the only species present in layers 16–19. *Pachymetopon blochii*, the most common fish in the BNK 1 sample, accounts for less than one per cent of the Elands Bay Cave sample.

Again counting the Clinidae and Blenniidae as representing only one genus each, there are 14 genera in the Elands Bay Cave sample as against 9 in that from BNK 1. Individual layer frequencies range from 1–3 genera in the lower layers and 3–7 in the upper. Although there are temporal differences between the layer groups designated 'lower' and 'upper' at the two sites, there is a greater similarity in the restricted numbers of genera at Elands Bay Cave and BNK 1 than there is between these two sites and Nelson Bay Cave.

DISCUSSION

Fish do not appear to have been as important a factor in the diet of the occupants of BNK 1 as they were to the inhabitants of Nelson Bay Cave, where fish can be considered a primary food resource that became more important in the course of time. Fish seem to have been important to the people of Elands

Bay Cave to a greater degree than to those of BNK 1, to perhaps the same degree as to those of Die Kelders, but to a much lesser degree in all three cases than to the people of Nelson Bay Cave. Because of the hiatus in the Elands Bay Cave sequence it is not possible to determine when fish became more important than they were in the late Pleistocene, but it is evident that at BNK 1, Nelson Bay Cave, Elands Bay Cave, and possibly Oakhurst, fish were more important in those parts of the deposits referable to the 'Wilton' than in the preceding period. Why fish should have become less important to the occupants of BNK 1 after about 4 000 B.P. and more particularly in layers 2 and 1 is a problem to which there is no ready solution.

Another problem is how the fish were caught. If the bone artefacts from BNK 1 layers 15–13 that have been termed 'fish gorges' (Fig. 31) really were such, they do not seem to have been very effective since these layers yielded a total of only four fish. The absence of these artefacts from the upper layers of BNK 1 (though not from those of Nelson Bay Cave), in which fish remains become more frequent, suggests that other, more efficient fishing methods had been devised. Poggenpoel (1979) has suggested that terminal Pleistocene–early Holocene environmental changes may have been responsible for at least some of the changes in the fish sample from Nelson Bay Cave while in the later Holocene the causal factor may have been technological.

Goodwin (1946), in an article on prehistoric fishing methods in South Africa, apparently concluded that the bulk of the fish caught, in 'Wilton' times at least, came from tidal fish traps. However, he quoted (pp. 139–140) the statement of a correspondent that a local fisherman at the Gouritz River mouth (Fig. 1) had found 'stuck away in a hole a fishing line made of a certain wild vine of fibrous texture. This had been shredded and turned into fishing line, and the hook was a bone tied in the middle and sharpened on each side'. Goodwin follows this statement by commenting that no such bones had yet been observed from midden deposits. This is perhaps not surprising in view of the apparent restriction of 'fish gorges' to deposits dated to the early 'Wilton' or earlier, although Goodwin might thus have found them at Oakhurst.

G. Avery has recorded the presence of a tidal fish trap at Franskraal, between Uilkraalsmond and Danger Point, and his details of catches from another trap, at Die Dam, a few kilometres east of Pearly Beach, include virtually all the genera recorded from BNK 1 (G. Avery 1975, fig. 1, tables 1–2). However, Mugilidae comprise about 70 per cent of the catches listed in Avery's table 2, while in the BNK 1 sample this family is represented by only three *Liza richardsoni*, and the most common fish in the BNK 1 sample, *Pachymetopon blochii*, is absent from the Die Dam catches. This seems to argue against the use of fish traps as the principal means of catching the fish represented in the BNK 1 sample. It may be that *Pachymetopon blochii* was caught on lines, using hooks other than 'fish gorges', and *Lithognathus* spp. are historically recorded as having been speared in the surf at False Bay by the Hottentots (Moodie 1838: 93).

Day (1970: 219), writing of the marine biology of False Bay, observed that *Johnius* (now *Argyrosomus*) *hololepidotus* and *Lithognathus lithognathus* congregate on the shallow, sandy shores of the bay during the summer. *Liza richardsoni* is among their prey, hunted in the surf. *Pomatomus saltator*, a warm-water fish, arrives in the bay by September and forms dense shoals by midsummer. *Lithognathus lithognathus* is the only species of the four that is present in the BNK 1 samples in anything approaching a relatively high frequency, but individual layer frequencies, even in layer 5, are low. The topography of the coast east of Danger Point is very different from that of False Bay and the total fish sample from BNK 1 is so small that it would seem unwise to use information such as that given by Day in an attempt to deduce the season during which BNK 1 might have been occupied.

REPTILES

In the Die Kelders faunal sample (Schweitzer 1979, tables 26–27) the dune mole-rat *Bathyergus suillus* outnumbers tortoise by a ratio of 4:1, while in the BNK 1 sample the position is reversed, with tortoise outnumbering dune mole-rat by almost 11:1. In the case of BNK 1 layer 1, within the time span of which the Die Kelders Holocene deposits fall, the ratio is almost 8:1. This is probably a reflection of the differing environments of the two sites, and the higher frequency of tortoise at BNK 1 suggests the greater ease with which these can be procured, as dune mole-rats are abundant in the area today.

The differing frequencies of tortoise at BNK 1 and Die Kelders may also reflect differential scheduling of activities: the people of Die Kelders might have had more time to devote to the trapping of dune mole-rats; they might have been there at a time of year when dune mole-rats were more plentiful than tortoises (winter: Schweitzer 1979: 206); or they might have had a greater need of, or use for, the pelts of these animals as well as their flesh.

The tortoise remains from Elands Bay Cave have been quantified only in terms of mass per cubic metre (Parkington 1979, table 4), so that no direct comparison with BNK 1 is possible. It appears, however, that the highest frequencies are in Elands Bay Cave layers 16–12, suggesting a greater exploitation of tortoise in the period 12 500–9 600 B.P., whereas at BNK 1 the period of relatively greater exploitation was 9 800–6 100 B.P.

GENERAL SUMMARY

In the preceding analyses and inter-site comparisons the various components of the BNK 1 assemblage have been dealt with individually and summarized on the basis of the major components. This general summary attempts to draw these components together and to group the layers in a chronological sequence according to what appear to be their common characteristics.

Table 26 presents those aspects of the assemblage considered to be most relevant to this summary. It will be immediately apparent that there is no point

at which an absolute division can be made between any of the layers or groups of layers across the whole range of components and that the division of the layers into 'phases' is thus arbitrary. It is also self-evident that not all the components have equal importance in the evaluation of change and that changes in frequency may be less important than changes in shape or style, or even presence or absence. The changes in the frequencies of stone raw materials, for example, have reduced significance when it is recalled that 71 per cent of the utilized artefacts and 85 per cent of the retouched pieces are silcrete. Similarly, the ranking of the mammal size classes becomes less important when it is remembered that these are based on numerical frequency rather than on total live mass, even though the size classes themselves are based on live mass. As an example, the eight individuals in the top-ranked very small size class in layer 16 have an estimated total live mass of less than 80 kg while the four individuals in the second-ranked large medium size class have an estimated total live mass in excess of 400 kg.

Phase 1

Layers 19 and 18 are characterized by a predominance of quartz as a raw material and higher frequencies of stone artefacts than the overlying layers. Layer 19 has the most unmodified and utilized blades (mostly silcrete) and blade cores (mostly quartz 'micro-blade') and yielded two backed blades. Layer 18 has few unmodified blades and blade cores, more utilized blades than flakes but no backed blades and a very high frequency of scaled pieces. Utilized stone artefacts: scaled pieces, flakes and blades, are more common than retouched pieces, which are mostly scrapers. There are very few bone artefacts, none of marine shell and very low frequencies of ostrich egg-shell beads. Layer 19 has part of an ostrich egg-shell 'flask' opening and layer 18 a fragment of decorated shell.

These layers share with layers 17 and 16 a similar ranking of the mammal size classes with the very small size class numerically most common and the large medium ranked second. The large size class ranks third in layer 19 but shares this position in layer 18 with the other two smaller size classes, suggesting a transition to the rank pattern of layers 17 and 16, in which this size class is absent from the top three rankings. They share with layers 17-13 the lowest frequencies of marine shell, with layers 17-11 the lowest frequencies of fish, and with layers 17-10 a predominance of grazing ungulates over browsers or 'mixed feeders'.

On the basis of the stone artefact frequencies it may be suggested that during phase 1 the cave was relatively more intensely occupied than during phase 2.

Phase 2

Layers 17-13 are characterized by a low density of stone artefacts in all three categories, although layer 13 has a higher frequency of retouched pieces

TABLE 26

Summary of artefactual and faunal data from BNK 1.

Phase	Date B.P.	Layer	STONE ARTEFACTS						
			Raw material ranking	AD/m ³	Unmodified	AD/m ³	Utilized	AD/m ³	Retouched
4	255-3 220	1	Q Qt L S	<10 ³	1-3: flakes: Qt Q S	<50	scaled pieces and flakes, no blades	<200	more segments (mostly
	3 400	2	Q Qt S L		1-4: few blades and blade cores				1-3: more adzes than scrapers
		3	Q Qt S L			<100		>300	2-3: few segments or backed scrapers
		3/4	4	Q S Qt L		flakes: Q Qt S	>100	scaled pieces and flakes, few blades	
3	3 900	5	S Q Qt L	>10 ³	5-6: flakes S Qt Q		highest frequencies of scaled pieces and flakes, few blades		5-9: segments and backed flakes most common; trapezoids in these layers only. Scrapers generally small and nearer to equilateral (circular)
		6	S Qt Q L		5-9: more blades, few blade cores				
		7	Q S Qt L		flakes: Qt S Q				
		8	S Q Qt L		flakes: S Qt Q				
	6 370 6 100	9	S Q Qt L						
	2/3	6 540	10	Q Qt S L		flakes: Qt Q S			<200
7 750		11	Q Qt S L	>2 × 10 ³	flakes: Q Qt S fewer blades and blade cores	<100	as 13-17		larger, longer scrapers
		12	Q S Qt L			>100	as 5-10	<300	first backed points (bo
		2	9 760	13	Q Qt S L	<10 ³	few blades and blade cores	<50	very few scaled pieces and flakes, no blades
14	Q Qt S L				13-18: flakes Qt Q S			<50	10-18: no backed blades
15	Qt Q L S				14-17: very few blades and blade cores				13-19: very few retouched pieces, mostly scrapers
16	Qt Q L S							16-17: segments in the layers only	
17	Qt Q S L			few blades and blade cores		as 13-16, but with few blades			
1	12 730		18	Q Qt S L	>10 ³		<100	mostly scaled pieces, more blades than flakes	
		19	Q Qt S L		flakes: Q Qt S most blades (S) and blade cores (Q 'micro')		flakes, most blades (S), scaled pieces		backed blades

Note. Raw materials: Q = quartz; Qt = quartzite; S = silcrete; L = limestone. Letters in parentheses are also materials.

AD/m³ = average density per cubic metre (see p. 24).

Mammals: VS = very small; S = small; SM = small medium; LM = large medium; L = large; + indicates equal ranking.

OES = ostrich egg-shell.

BONE ARTEFACTS	MARINE SHELL ARTEFACTS	OTHER ARTEFACTS	MAMMALS		SHELL-FISH		FISH
			Size class ranking		AD/m ³		AD/m ³
most and best range	most <i>Donax</i> scrapers	pottery, metal bead, OES pendants	VS SM S	first sheep	> 2 000	more <i>Choro-</i> <i>mytilus-Perna</i>	< 5
very few	no <i>Donax</i> scrapers	no OES pendants	VS S SM	more browsers/ mixed feeders (bovids)	-----	more <i>Oxyste-</i> than <i>Turbo</i> 1-9; <i>Turbo</i> <i>sarmaticus</i> generally most common species	< 20
			VS S SM		> 12 000		> 20
very few	1-9: shell pendants and perforated whole shell ornaments		VS S SM		> 2 000		-----
first (?) points and linkshafts		first OES pendants	VS S SM				> 50
more artefacts than above or below	<i>Donax</i> scrapers	first OES discs	VS S SM	first (?) <i>Raphi-</i> <i>cerus</i> <i>campestris</i>	-----		-----
		ADs for OES beads > 400; most decorated OES	VS S SM		> 1 000		> 20
very few, mostly vols			VS S SM				-----
			VS S SM	last <i>Equus</i> cf. <i>quagga</i>			< 20
		ADs for OES beads < 100; other OES artefacts rare or absent	S SM+LM VS		< 200	<i>Donax serra</i> generally most common species	< 10
one			LM VS S+SM	last <i>Damaliscus</i> <i>dorcas</i>			< 5
	first <i>Donax</i> scrapers		LM S VS+S				
15: 'fish gorges'	perforated whole shell ornaments only (no pendants)		LM VS SM	more grazers (bovids and equids)	< 50		
			LM VS+SM S				
			LM VS S				
very few			VS LM S+SM				
			VS LM S+SM				
			VS+LM S+SM+L				
	no artefacts or ornaments		VS LM L	<i>Equus</i> cf. <i>capensis</i>			

TABLE 26

Summary of artefactual and faunal data from BNK 1.

Phase	Date B.P.	Layer	STONE ARTEFACTS						BONE ARTEFACTS	MARINE SHELL ARTEFACTS	OTHER ARTEFACTS	MAMMALS		SHELL-FISH		FISH	
			Raw material ranking	AD/m³	Unmodified	AD/m³	Utilized	AD/m³				Retouched	Size class ranking	AD/m³	AD/m³		
4	255-3 220	1	Q Qt L S	<10³	1-3: flakes: Qt Q S	<50	scaled pieces and flakes, no blades	<200	more segments (mostly Q)	most and widest range	most <i>Donax</i> scrapers	pottery, metal bead, OES pendants	VS SM S	first sheep	>2 000	more <i>Choromytilus-Perna</i>	<5
	3 400	2	Q Qt S L		1-4: few blades and blade cores			1-3: more adzes than scrapers	very few	no <i>Danax</i> scrapers	no OES pendants	VS S SM	more browsers/mixed feeders (bovids)			<20	
		3	Q Qt S L			<100		2-3: few segments or backed scrapers					VS S SM				
	3/4	4	Q S Qt L		flakes: Q Qt S	>100	scaled pieces and flakes, few blades		4-6: backed scrapers most common	few	1-9: shell pendants and perforated whole shell ornaments		VS S SM		>12 000 >2 000	more <i>Oxysteles</i> than <i>Turbo</i> 1-9: <i>Turbo sarmaticus</i> generally most common species	>20
3	3 900	5	S Q Qt L	>10³	5-6: flakes S Qt Q		highest frequencies of scaled pieces and flakes, few blades		5-9: segments and backed flakes most common; trapezoids in these layers only. Scrapers generally smaller and nearer to equilateral (circular)	first (?) points and linkshafts		first OES pendants	VS S SM				>50
		6	S Qt Q L		5-9: more blades, few blade cores					more artefacts than above or below	<i>Danax</i> scrapers	first OES discs	VS S SM	first (?) <i>Raphicercus campestris</i>			
		7	Q S Qt L		flakes: Qt S Q							ADs for OES beads >400; most decorated OES	VS S SM		>1 000		>20
	6 370	8	S Q Qt L		flakes: S Qt Q					very few, mostly awls			VS S SM	last <i>Equus</i> cf. <i>quagga</i>			<20
	6 100	9	S Q Qt L										VS S SM				
2/3	6 540	10	Q Qt S L		flakes: Qt Q S			<200	first backed scrapers; scraper size decreases			ADs for OES beads <100; other OES artefacts rare or absent	S SM + LM VS		<200	<i>Donax serra</i> generally most common species	<10
		11	Q Qt S L	>2 × 10³	flakes: Q Qt S fewer blades and blade cores	<100	as 13-17		larger, longer scrapers	none			LM VS S+SM	last <i>Damaliscus dorcas</i>			<5
	7 750	12	Q S Qt L			>100	as 5-10	<300	first backed points (borers)		first <i>Danax</i> scrapers		LM S VS+S				
2		13	Q Qt S L	<10³	few blades and blade cores	<50	very few scaled pieces and flakes, no blades	<100	scraper size increases; first borers (drills)	13-15: 'fish gorges'	perforated whole shell ornaments only (no pendants)		LM VS SM	more grazers (bovids and equids)	<50		
	9 760	14	Q Qt S L		13-18: flakes Qt Q S			<50	10-18: no backed blades				LM VS+SM S				
		15	Qt Q L S		14-17: very few blades and blade cores				13-19: very few retouched pieces, mostly scrapers	very few			LM VS S				
		16	Qt Q L S						16-17: segments in these layers only				VS LM S+SM				
		17	Qt Q S L		few blades and blade cores		as 13-16, but with few blades				no artefacts or ornaments		VS LM S+SM				
1		18	Q Qt S L	>10³		<100	mostly scaled pieces, more blades than flakes						VS + LM S+SM+L				
	12 730	19	Q Qt S L		flakes: Q Qt S most blades (S) and blade cores (Q 'micro')		flakes, most blades (S), scaled pieces		backed blades				VS LM L	<i>Equus</i> cf. <i>capensis</i>			

Note. Raw materials: Q = quartz; Qt = quartzite; S = silcrete; L = limestone. Letters in parentheses are also raw materials.

AD/m³ = average density per cubic metre (see p. 24).

Mammals: VS = very small; S = small; SM = small medium; LM = large medium; L = large; + indicates equal ranking.

OES = ostrich egg-shell.

than the other layers. Quartzite is the predominant raw material in layers 17–15 and quartz in layers 14 and 13. Unmodified flakes are, however, mostly quartz and there are few unmodified blades and blade cores, very few in layers 16–14. Utilized blades occur in layer 17 but not in layers 16–13, and there are no backed blades in any of the layers. There are segments in layers 17 and 16 but the few retouched pieces are mostly scrapers. A change in scraper morphology appears to begin in layer 13, that continues into phase 2/3. The first borers (drills) were recovered from layer 13.

As in phase 1, there are very few bone artefacts in the layers of phase 2, and 'fish gorges' are restricted to layers 15–13. The first shell ornaments, simple perforated shells, occur in layer 16 but phase 2 shares with phase 1 a paucity of marine shell, mostly *Donax serra* as well as very low ADs for beads and other artefacts of ostrich egg-shell.

Layers 17 and 16 form a group with those of phase 1 in the ranking of the mammal size classes, with the very small and large medium size classes in the first two rankings. Layer 15–13, on the other hand, share with layers 12 and 11 a predominance of the large medium size class, with the very small size class generally ranked second. These layers are the only ones in which the large medium size class is numerically predominant but the ungulates are, like those of phases 1 and 2/3 mostly grazers. As in phase 1, fish are sparsely represented.

Apart from the fact that there is no evident decline in the relative frequency of mammals, phase 2 appears to indicate a period of less intensive occupation of the cave than during phase 1. The 'fish gorges' in layers 15–13, the first occurrence of marine shell ornaments in layer 16 and of borers (drills) in layer 13 as well as the beginning (?) of a change in scraper morphology in layer 13 all indicate a degree of technological difference from phase 1, and the changes in the mammal size class rankings suggest a degree of economic change.

Phase 2/3

Layers 12–10 share with the upper layers of phase 2 a predominance of quartz, although layer 12 is anomalous in having silcrete ranked second whereas the other layers have quartzite. Layers 12 and 11 have the highest ADs for stone artefacts of all the layers, while layer 10 belongs to phase 3 in this respect. Unmodified flakes are mostly quartz in layers 12 and 11 but quartzite in layer 10, and all three layers share with phase 3 an increase in unmodified blades relative to phase 2, but there are still very few blade cores. Layers 12 and 10 are more like phase 3 in the frequency of utilized artefacts while layer 11 is more like phase 2. Layer 12 has a higher frequency of retouched artefacts than layers 11 and 10 and has the first backed points (borers), while the first backed scrapers came from layer 10. In layer 11 the change in scraper morphology first observed in layer 13 reaches its peak (but see p. 47), while layer 10 sees the beginning of a reversion to a smaller, more equilateral (rounder) type. There are no bone artefacts in layers 12 and 11 and very few in

layer 10. The first *Donax serra* 'scrapers' came from layer 12 but marine shell ornaments continue to be the simple perforated shells first recorded in layer 16. These layers share with phases 1 and 2 very low frequencies of ostrich egg-shell artefacts.

Layers 12 and 11 are like the upper part of phase 2 (layers 15–13) in the ranking of the mammal size classes while layer 10 suggests a pattern intermediate between that of the upper part of phase 2 and that of phases 3 and 4. There are still more grazers than browsers or mixed feeders but the last *Damaliscus dorcas* recorded at the site came from layer 11. Shellfish frequencies are still low, but higher than in phases 1 and 2, and *Donax serra* continues to be the most common species in layers 12 and 11 while in layer 10 *Turbo sarmaticus* assumes the dominant position it holds in most of the upper layers. Fish frequencies are higher in layer 10 than in layers 19–11, but still low.

As the numbering indicates, phase 2/3 is seen as transitional between phases 2 and 3. While in many respects continuing the pattern of phase 2 it presages that of phase 3 and in general suggests an increase in the intensity of the occupation of the cave as well as some changes in the technology and economy of the cave occupants. Layer 10, it may be recalled, marks the division between D. M. Avery's vegetation units 3 and 2, although Avery has suggested that the climate of phase 2/3 was milder than that of phase 2 (cf. Table 22).

Phase 3

Layers 9–5 are marked by a predominance of silcrete as a raw material, except in layer 7 in which quartz predominates. The ADs for unmodified artefacts are lower than for phase 2/3 but higher than for phases 2 or 4 and in the same range as for phase 1. Unmodified flakes are more commonly quartz in layers 7 and 6 but silcrete in the other layers. There are generally more unmodified blades than in phases 2 and 2/3 but still few blade cores. The ADs for utilized artefacts are the highest except for layer 12 and scaled pieces and flakes continue to be the most common types. Layer 8 has the highest frequency of utilized blades after layer 19, but frequencies of these are generally low throughout the sequence. The highest frequencies of retouched artefacts are in layers 9–3 and it is generally characteristic of phase 3 that the layers contain the fullest range of retouched artefact types, which are only sporadically present in the underlying layers. Scrapers are still the most common retouched artefacts but while those of layer 9 are morphologically intermediate between those of layers 13–10 and 8–1, those of layers 8–5 show a greater degree of homogeneity and are generally in the small to medium size class (< 30 mm). Apart from layer 1, segments have their highest frequencies in phase 3, as do backed flakes. Trapezoids occur only in phase 3 and backed scrapers are most common in layers 6–4.

Bone artefacts are still few although there are more in layers 7–5 than in the underlying layers. The first positively identifiable points and linkshafts

occur in layer 5 but may be present from layer 6. Marine shell 'pendants' first occur in layer 9 while the simple perforated shell ornaments present from layer 16 continue to be found. After layer 1, the layers of phase 3 have the highest frequencies and widest range of these artefacts. Ostrich egg-shell beads and decorated ostrich egg-shell are also most common in phase 3.

The ranking of the mammal size classes is virtually identical in layers 9–1, with the three smaller size classes predominant. Layer 9 contains the last *Equus* cf. *quagga* recorded from the site and marks a change from a predominance of grazing ungulates in the lower layers to a predominance of browsers and mixed feeders. The first positively identified *Raphicercus campestris* occurs in layer 6. The frequency of shellfish increases markedly in layer 9 and frequencies generally continue to increase throughout this phase, with *Turbo sarmaticus* the most common species. Fish frequencies, although still low, also increase in phase 3 and the site maximum is reached in layer 5.

Phase 3 suggests the highest intensity of occupation of the cave of the whole BNK 1 sequence. Where artefacts are concerned there is an increase in frequency rather than in range, although there are some technological innovations and changes. Change is more marked in the faunal component, with a decline in the general size range of the mammals brought back to the site and a marked increase in the amount of shellfish as well as a less marked increase in fish frequencies.

Phase 3/4

Layer 4 is intermediate between the layers of phase 3 and those of phase 4. It shares with phase 4 a predominance of quartz and lower ADs for unmodified artefacts than phase 3 and few blades and blade cores, but the flakes are mostly quartz whereas in phase 4 they are mostly quartzite. It shares with phase 3 a higher frequency of utilized artefacts than phase 4 and contains utilized blades, which are absent from phase 4. The retouched artefact category also has more in common with phase 3 although it contains a higher frequency of adzes. In layer 5 the scraper : adze ratio is about 6 : 1, in layer 4 it is 6 : 4. There are few bone artefacts and the layer contains *Donax serra* 'scrapers' and ostrich egg-shell 'pendants', both of which are, perhaps fortuitously, absent from layers 3 and 2 but present in layer 1.

The ranking of the mammal size classes is the same as for phases 3 and 4 and shellfish ADs are similar to those for the upper layers of these two phases, but fish frequencies are lower than in phase 3.

Phase 3/4 appears to mark the beginning of a period of reduced intensity of occupation of the cave but provides few indications of technological or economic change.

Phase 4

The final occupation phase of BNK 1 has quartz as its predominant raw material, a lower frequency of unmodified artefacts than phase 3, a predomi-

nance of quartzite flakes and few blades and blade cores. There is also a reduction in the frequency of utilized artefacts and this category contains no blades in these layers. In layer 3 the AD for retouched pieces is the same as for phase 3 but it drops in layers 2 and 1. The most notable difference of phase 4 from phase 3 is that adzes are more common than scrapers. Backed scrapers and segments are few, except in layer 1, in which the frequency of segments is as high as in phase 3, though in layer 1 they are mostly quartz.

Layers 3 and 2 have very few bone artefacts but layer 1 has the highest frequency and the fullest range of all the layers. Layer 1 also has the most *Donax serra* 'scrapers', while layers 2 and 3 have none. Other artefacts restricted to layer 1 are potsherds and the site's single metal artefact.

Where the fauna is concerned, phase 4 is not markedly different from phase 3, with the notable exception of *Ovis aries* in layer 1. Layer 3 has a very high density of marine shell and *Oxystele sinensis* is more common than *Turbo sarmaticus* which, however, remains the dominant species in terms of flesh mass. Shellfish and fish frequencies decline in layers 2 and 1 and in layer 1 there is a marked increase in the frequency of *Choromytilus meridionalis* relative to the frequencies in the underlying layers. Domestic sheep are present only in layer 1, and this causes a change in the ranking of the small medium size class which in this layer ranks second whereas it ranked third in the underlying layers.

Phase 4 appears to mark a period of less intensive occupation of the cave than in phase 3. This is particularly noticeable in the wide range of dates for layer 1 relative to the depth of deposit. Technological change is indicated by the predominance of adzes and an overall decline in the frequency of scrapers, while in layer 1 bone artefacts and *Donax serra* 'scrapers' reach their highest frequencies and segments are as common as in phase 3. Economic change is indicated by the decline in the frequency of marine resources and, in layer 1, by the addition of domestic sheep to the range of wild game already available.

DISCUSSION

By and large, it would seem that in the BNK 1 assemblage technological change is not concomitant with economic change. The site data indicate for the lower layers a general emphasis on large medium mammals, mostly bovids, little reliance on marine resources and very little use of artefacts, in the cave at least. From layer 12, or perhaps layer 13, technological changes are evident in the addition of new types of retouched artefacts, although these represent only a third of the total range of artefact types in this category. There is a change in scraper morphology evident in layers 13-9 which might have proved less significant had larger samples been available for layers 19-13 and 11; and the replacement of the dominance of scrapers in layers 19-4 by that of adzes in layers 3-1 is undoubtedly also not without significance, although the functional relationship between these two artefact types has yet to be demonstrated. The addition, from layer 9 up, of the more elaborate shell pendants to the range of

ornaments already available suggests an increase in the leisure (?) time of at least some of the cave occupants—leisure, that is, from the necessary aspects of day-to-day life although the shift in resources from the larger animals of the lower layers to a range of smaller fauna that includes shellfish and fish suggests a change to a way of life that was more labour-intensive. In this connection it is worth reiterating the social change implicit in the change of the economic base from that of the lower layers to that of the upper. It seems axiomatic, in simple societies at least, that the greater the dependence on communal effort in resource procurement, the greater the obligation for those resources to be shared and therefore the greater the sense of community. The analogy of the !Kung may not be directly applicable to the prehistoric and early historic hunter-gatherers of the southern Cape but the evidence here (Marshall 1976: 295–303) is that, while sharing is an essential need of the community, the obligation to share does not extend to smaller game, plant foods and the like. The change in the BNK 1 fauna from that of the lower layers to that of the upper is primarily one of a change from the procurement of large game to that of smaller game, shellfish and fish (and presumably plant foods), resources that would require more individual effort to procure and thus a diminution of the need or obligation to share those resources. Although this need not necessarily result in a weakening of the sense of community it does indicate an increase in the degree of individualistic behaviour within that community and therefore some measure of social change.

On the basis of general similarities, phase 1 can be related to the 'Robberg industry' and phase 2 to the 'Albany' (H. J. Deacon 1976: 76–78, 117–122; J. Deacon 1978: 100–109), although it is possible that phase 1 may mark the transition from the 'Robberg' to the 'Albany', in the same way as layer BSL at Nelson Bay Cave seems to do. Phase 3 would unquestionably be termed 'Wilton' and, by analogy, phase 2/3 'Formative Wilton' and phases 3/4 and 4 'Post-climax Wilton' (cf. H. J. Deacon 1976, table 3). The problem of the nomenclature and content of the 'industries' of the Late Stone Age of southern Africa has recently again been raised by Parkington and discussed by various commentators on his paper (Parkington 1980a and comments thereon). It is not considered appropriate to this report (especially since in its published form it lacks the conclusions of the principal author) to enter into this debate which, it is felt, is only likely to be resolved by the publication of detailed reports from a greater number of sites in a greater variety of localities.

The BNK 1 data indicate that at one level there is some justification for viewing the sequence as consisting of two major units, one from the initial occupation of the cave some 12 700 years ago until about 6 000 B.P. and the second from the latter date until the final occupation of the cave. They also indicate reasonable validity for the division into 'phases' based on a certain degree of homogeneity in technology and economy. What they indicate above all, however, is the arbitrariness of these divisions and they emphasize that change, to greater or lesser degree but none the less *change*, was continual

throughout the occupation of the site, and that it was diachronous rather than synchronous. The relevance of this to the ecology of the human inhabitants of the region cannot be determined from the site data alone and requires substantiation from other sites in the area as well as from independently-derived environmental data. The interaction between man and his environment, viewed from the perspective of archaeological data alone, is at best one-sided since it presents aspects of man's use of his environment without the correlate of that environment's effect on man. In this regard, it is regrettable that the sparseness of the final deposits precludes more detailed observation of what may have been the most significant effect of man on the environment of the Cape: the introduction of pastoralism.

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APPENDIX 1

BYNESKRANSKOP 1: MAMMALS. TABLES OF THE MINIMUM
NUMBERS OF INDIVIDUALS REPRESENTED BY VARIOUS
SKELETAL PARTS

By

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(Compiled January 1978)

TABLE I
Raphicerus spp.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Frontlet	4	1	1	—	4	—	1	—	—	1	—	—	1	1	—	2	—	—	1
Occipital condyle	4	—	2	2	9	4	3	1	2	1	—	—	—	—	—	1	1	—	—
Maxilla	5	4	—	3	20	7	4	4	4	—	—	2	—	3	2	—	1	—	1
Mandibular condyle	3	—	—	2	17	5	3	—	1	—	—	—	—	1	1	—	—	—	—
Mandibular dentition	9	3	3	8	23	7	5	3	3	3	1	3	2	3	1	2	1	—	1
Atlas	1	—	1	—	10	2	—	1	1	—	—	—	1	—	—	1	—	—	—
Axis	1	—	1	3	13	3	3	4	2	2	—	—	—	1	—	—	—	—	—
Cervical vertebrae 3-7	3(1+2)	10(1+1)	1(0+1)	—	7(3+4)	2(1+1)	10(1+1)	2(1+1)	2(1+1)	10(1+1)	10(1+1)	—	1(1+0)	2(1+1)	1	—	—	—	—
Thoracic vertebrae	3(1+2)	2(1+1)	2(1+1)	2(1+1)	5(3+2)	2(1+1)	1(1+0)	2(1+1)	2(1+1)	10(1+1)	10(1+1)	—	—	1(0+1)	—	—	—	—	—
Lumbar vertebrae	10(1+1)	—	—	2(1+1)	4(1+3)	2(1+1)	1(1+0)	1(1+0)	2(1+1)	—	—	—	1(1+0)	1(0+1)	—	—	—	—	—
Sacral vertebrae	3	1	1	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Scapula	6	2	2	—	2	1	1	—	1	—	—	—	—	2	—	—	—	—	—
Humerus — proximal	1(0+1)	2(1+1)	1(1+0)	1(0+1)	8(2+6)	—	1(1+0)	1(0+1)	—	1(0+1)	—	—	1(0+1)	—	—	1(1+0)	—	—	—
— distal	7(3+4)	1(1+0)	2(1+1)	1(0+1)	17(4+13)	5(1+4)	2(0+2)	1(0+1)	4(0+4)	—	—	10(1+1)	—	—	1(0+1)	2(1+1)	—	—	—
Radius — proximal	6(1+5)	—	3(1+2)	2(0+2)	8(1+7)	5(0+5)	1(0+1)	—	1(0+1)	—	1(0+1)	—	1(0+1)	—	—	1(1+0)	—	—	—
— distal	3(2+1)	1(1+0)	2(1+1)	1(0+1)	7(3+4)	3(1+2)	1(0+1)	1(1+0)	3(1+2)	—	—	—	—	1(0+1)	—	—	—	—	—
Ulna — proximal	9(3+6)	2(1+1)	2(2+0)	2(1+1)	10(4+6)	5(2+3)	1(0+1)	1(0+1)	3(2+1)	1	1(1+0)	1(1+0)	—	1(1+0)	—	—	—	—	—
— distal	3	—	—	3	10	6	2	1	2	—	—	—	—	—	—	—	—	—	—
Magnum	2	—	—	1	6	6	3	1	—	—	—	—	—	—	—	—	—	—	—
Scaphoid	4	—	—	1	12	6	3	2	3	1	1	1	—	—	1	1	—	—	—
Cuneiform	6	—	1	2	8	4	3	1	1	—	—	—	—	—	—	—	—	—	—
Lunate	5	—	1	2	9	2	2	—	1	—	—	—	—	—	—	—	—	—	—
Ulniform	3	—	1	1	3	3	1	—	2	—	—	—	—	—	—	—	—	—	—
Metacarpal — proximal	6(2+4)	1(1+0)	4(3+1)	1(1+0)	6(3+3)	3(1+2)	1(1+0)	1(1+0)	—	1(0+1)	—	—	1	1	1	—	—	—	—
— distal	5(2+3)	2(1+1)	3(1+2)	2(1+1)	7(2+5)	3(1+2)	2(1+1)	1(0+1)	1(0+1)	1(0+1)	2(1+1)	—	2(1+1)	1(0+1)	1(0+1)	1(0+1)	—	—	1(0+1)
Phalanges — 1st	4(2+2)	2(1+1)	2(1+1)	2(1+1)	7(2+5)	4(1+3)	1(0+1)	2(1+1)	2(1+1)	1(0+1)	2(1+1)	1(1+0)	2(1+1)	1(0+1)	1(0+1)	1(0+1)	—	—	1(0+1)
— 2nd	4	2	2	3	8	4	1	1	1	1	1	1	1	1	—	1	—	—	1(0+1)
— 3rd	4	—	1	1	10	1	1	1	3	—	—	2	—	—	—	—	—	—	1(0+1)
Ilium	5	1	—	2	11	1	—	—	2	1	—	—	—	—	—	—	—	—	—
Ischium	4	—	1	—	9	6(2+4)	2(1+1)	1	2	1	—	1	—	—	—	—	—	—	—
Pubis	5(4+1)	3(2+1)	—	—	13(5+8)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Femur — proximal	3(2+1)	2(1+1)	1(1+0)	3(1+2)	5(2+3)	2(1+1)	—	1(0+1)	2(1+1)	—	—	—	1(1+0)	2(1+1)	1	1(0+1)	—	—	1(0+1)
— distal	3(2+1)	2(1+1)	1(1+0)	1(1+0)	5(1+4)	—	1(1+0)	—	2(1+1)	—	1(1+0)	1(1+0)	—	1(1+0)	1(1+0)	—	—	—	—
Tibia — proximal	4(1+3)	1(0+1)	2(1+1)	4(2+2)	8(1+7)	3(1+2)	2(1+1)	3(1+2)	2(0+2)	—	—	—	1(1+0)	1(0+1)	1(1+0)	—	—	—	—
— distal	7	1	1	2	10	2	1	2	2	1	—	—	—	1(1+0)	1(1+0)	—	—	—	—
Patella	7	2	1	3	11	4	3	1	—	1	—	—	—	—	—	1	—	—	—
Calcaneum	9	1	2	3	11	4	3	1	—	—	—	—	—	—	—	—	—	—	—
Astragalus	5	2	1	2	10	2	2	1	—	1	—	1	2	2	—	1	—	—	1
Cuneiform 1	3	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
2	3	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Lateral malleolus	3	1	—	1	7	4	—	2	1	—	—	—	—	—	—	—	—	—	—
Naviculo-cuboid	3	1	—	1	8	4	1	1	1	—	—	—	—	—	—	—	—	—	—
Metatarsal — proximal	3	1	1	2	5	3	1	1	5	1	—	—	—	1	1	—	—	—	—
— distal	3(1+2)	1(0+1)	1(1+0)	2(0+2)	8(3+5)	2(1+1)	—	—	—	1(0+1)	—	—	—	—	—	—	—	—	—
Sesamoids — proximal	2	—	1	—	2	1	1	1	1	—	—	—	—	—	—	—	—	—	—
— distal	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Indeterminate distal	4(1+3)	2(1+1)	—	—	2(1+1)	4(2+2)	2(1+1)	2(1+1)	2(1+1)	1(1+0)	—	—	1(0+1)	2(1+1)	1(0+1)	—	—	—	1(0+1)
Hyoids	2	—	—	1	2	2	—	—	2	—	—	—	—	—	—	—	—	—	—

Note. In this and the following tables numbers in parentheses indicate the numbers of individuals represented by unfused and fused epiphyses.

TABLE 4

[illegible]

TABLE 6
Bathergus suillus.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Occipital condyle.....	9	1	1	3	22	5	—	1	1	1	1	—	—	—	—	2	1	—	3
Mandibular condyle..	29	2	3	9	37	3	1	1	3	1	1	1	1	—	1	2	1	—	3
Mandibular dentition.	37	6	5	19	49	12	5	4	5	1	2	1	1	—	2	6	4	—	12
Maxilla.....	20	1	5	7	49	9	1	1	1	1	2	1	1	—	—	3	3	—	7
Atlas.....	12	1	1	2	8	4	—	—	1	—	—	—	—	—	—	1	—	—	1
Axis.....	3	2	—	2	13	2	—	—	1	—	—	—	—	—	—	—	1	—	1
Cervicals 3-7.....	3	1	1	1	6	2	—	1	1	—	—	—	1	—	—	—	—	—	—
Thoracic vertebrae....	2	1	1	1	6	3	—	—	1	—	1	1	—	—	—	1	1	—	1
Lumbar vertebrae....	6	2	1	1	18	4	1	—	1	—	—	—	—	1	—	1	—	—	1
Sacral vertebrae.....	5	—	—	—	8	2	1	—	—	—	—	—	—	—	—	—	—	—	—
Scapula.....	11	2	2	5	27	5	—	1	—	—	—	—	—	2	—	2	—	—	3
Humerus — proximal ..	12(10+2)	2(2+0)	1(1+0)	3(3+0)	17(15+2)	6(4+2)	2(1+1)	1(1+0)	2(1+1)	—	1(1+0)	1(1+0)	—	—	1	—	2(1+1)	—	2(1+1)
— distal.....	21(1+20)	4(0+4)	2(0+2)	5(0+5)	23(0+23)	5(0+5)	1(0+1)	2(0+2)	1(0+1)	—	1(0+1)	1(0+1)	—	1(0+1)	—	—	2(0+2)	—	1(0+1)
Radius — proximal ..	9(1+8)	3(2+1)	1(1+0)	2(0+2)	12(3+9)	4(1+3)	—	—	1(0+1)	—	—	—	—	—	—	1(0+1)	1(0+1)	—	2(1+1)
— distal.....	3(1+2)	3(1+2)	1(0+1)	3(1+2)	9(5+4)	4(3+1)	—	—	—	—	—	—	—	—	—	—	1(0+1)	—	3(1+1)
Ulna — proximal ..	15(11+4)	4(3+1)	3(3+0)	5(4+1)	17(15+2)	4(3+1)	—	—	2(1+1)	1(1+0)	1(1+0)	—	—	2(1+1)	1(1+0)	4(3+1)	1(0+1)	—	5(3+2)
— distal.....	6(4+2)	2(2+0)	3(3+0)	4(2+2)	10(9+1)	2(2+0)	1(1+0)	—	—	—	1(1+0)	—	—	—	—	1	1	—	3(3+0)
Ribs.....	7	1	2	2	7	3	1	1	1	1	1	1	1	1	1	1	1	—	1
Clavicles — proximal ..	7	1	3	1	5	3	1	1	1	1	—	—	—	—	—	—	—	—	2
— distal.....	6	1	3	—	6	3	1	1	1	1	—	—	—	—	—	—	—	—	1
Ilium.....	7	2	2	2	16	6	1	1	1	1	—	—	1	2	—	1	1	—	2
Ischium.....	9	1	2	4	17	6	1	1	1	1	—	—	1	1	—	1	1	—	1
Pubis.....	8	—	1	2	13	6	1	—	1	1	—	—	1	1	—	1	1	—	1
Femur — proximal ..	15(10+5)	4(3+1)	3(2+1)	4(3+1)	20(16+4)	4(3+1)	1(1+0)	—	3(2+1)	1(1+0)	—	—	2(2+0)	1(1+0)	1(1+0)	1(1+0)	1	—	2(2+0)
— distal.....	12(9+3)	5(3+2)	3(2+1)	3(2+1)	16(14+2)	6(5+1)	1(1+0)	—	3(2+1)	1(1+0)	—	—	1(1+0)	1(1+0)	1(1+0)	—	—	—	3(3+0)
Tibia — proximal ..	9(8+1)	2(2+0)	2(1+1)	5(4+1)	19(17+2)	7(6+1)	1(1+0)	—	1(1+0)	—	1(1+0)	1(1+0)	1(1+0)	1(1+0)	—	—	—	—	1(1+0)
— distal.....	14(4+10)	2(0+2)	2(1+1)	3(2+1)	16(4+12)	6(0+6)	2(2+0)	1(0+1)	—	—	1(0+1)	1(0+1)	—	1(0+1)	1(0+1)	1(0+1)	—	—	1(0+1)
Patella.....	5	—	—	1	5	3	1	—	—	—	—	—	—	—	—	1	—	—	—
Calcaneum.....	4	1	—	2	7	1	1	—	—	—	—	1	—	1	1	—	—	—	2
Astragalus.....	10	1	1	1	4	2	2	—	1	—	—	—	—	1	—	1	—	—	2
Metapodials.....	6	—	1	1	3	2	1	—	1	—	1	—	—	1	—	1	1	—	1

TABLE 7
Various species (1).

<i>Arctocephalus pusillus</i>	1	4	5	6	7	9	10	11	12	13	14	16	17	
Occipital condyle	1	—	—	—	—	—	—	—	—	—	—	—	—	
Mandibular condyle	—	—	—	1	—	—	—	—	—	—	—	—	—	
Dentition	1	1	1	2	1	—	—	—	1	—	—	—	1	
Atlas	—	—	1	—	—	—	—	—	—	—	—	—	—	
Axis	—	—	—	—	—	—	—	—	—	—	—	—	—	
Cervicals 3-7	1	—	1	—	—	—	—	—	—	—	—	—	—	
Thoracic	—	—	1	—	—	—	—	—	—	—	—	—	—	
Lumbar	1	—	—	—	—	—	—	—	—	—	—	—	—	
Sacral	—	—	1	—	—	—	—	—	—	—	—	—	—	
Scapula	1	—	—	—	—	—	—	—	—	—	—	—	—	
Humerus—proximal	1(1+0)	—	—	—	—	—	—	—	1	—	—	—	—	
—distal	—	—	—	1(0+1)	—	—	—	—	—	—	—	—	—	
Radius—proximal	1(1+0)	—	1(1+0)	—	—	—	—	—	—	—	—	—	—	
—distal	—	—	—	1(0+1)	—	—	—	—	—	—	—	—	—	
Ulna—proximal	2(1+1)	—	1(1+0)	—	—	—	—	—	—	—	—	—	—	
—distal	—	—	1(1+0)	—	—	—	—	—	—	—	—	—	—	
Carpals	1	—	1	—	1	—	—	—	—	—	—	—	—	
Ilium	—	—	—	—	—	—	—	—	—	—	—	—	—	
Ischium	—	—	—	—	—	—	—	—	—	—	—	—	—	
Pubis	—	—	—	—	—	—	—	—	—	—	—	—	—	
Femur—proximal	—	—	—	1(1+0)	—	—	—	—	—	—	—	—	—	
—distal	—	—	—	2(1+1)	—	—	—	—	—	—	—	—	—	
Tibia—proximal	—	—	1(1+0)	—	—	—	—	—	—	—	—	—	—	
—distal	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fibula—proximal	—	—	—	—	—	—	—	—	—	—	—	—	—	
—distal	—	—	1(1+0)	—	—	—	1(1+0)	—	—	—	—	—	—	
Patella	1	—	—	—	—	—	—	—	—	—	—	—	—	
Calcaneum	—	—	—	1	—	—	—	—	—	—	—	—	—	
Astragalus	—	—	—	1	—	—	—	—	1	—	—	—	—	
Other tarsals	1	—	1	—	—	—	—	—	—	—	—	—	—	
Metapodials	1	—	1	1	—	—	—	—	—	—	—	—	—	
Phalanges	1	1	1	1	1	1	1	1	1	1	—	1	1	
<i>Leporidae</i> gen. et sp. indet.	1	2	6	8	9	10	11	13	14	15	16	17	18	19
Maxilla	—	—	—	1	1	—	—	—	—	—	—	—	—	—
Mandible	—	—	—	1	2	—	—	1	1	1	1	—	—	1
Cervicals 3-7	—	—	?1	—	—	—	—	—	—	—	—	—	—	—
Thoracic vertebrae	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Lumbar vertebrae	—	—	?1	1	—	—	—	—	—	—	1	—	—	1
Scapula	1	—	—	—	—	1	—	—	—	—	—	3	—	—
Humerus—proximal	1(0+1)	—	—	—	—	—	—	—	—	—	—	—	—	1(0+1)
Radius—distal	—	—	—	—	—	—	—	—	—	—	—	1(0+1)	—	1(0+1)
Ulna—distal	—	—	—	—	—	1(0+1)	—	—	—	—	—	—	—	—
Carpals	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Femur—proximal	1(0+1)	—	—	—	—	1(0+1)	—	—	—	—	—	—	—	—
—distal	1(0+1)	—	—	—	—	—	—	—	—	—	—	—	—	1(0+1)
Tibia—proximal	—	—	—	—	—	—	—	—	—	—	—	—	—	1(0+1)
Metapodials	1	—	—	1	—	—	1	1	—	—	—	—	1	1
Phalanges	—	—	—	—	—	—	—	—	—	—	1	1	—	—
Ribs	—	—	—	1	—	—	—	—	—	—	—	—	—	—
<i>Diceros bicornis</i>	6	9	11	14	16									
Dentition	1	1	1	1cf.	1cf.									
<i>Rhinocerotidae</i>	1	5	6	8	9	11	12	14	15	16	17	19		
Dentition	1	—	1	—	1	1	?1	1	1	1	1	1	—	—
Tarsals	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Phalanges	1	—	—	1	—	—	—	—	—	—	—	—	—	—
Sesamoids—proximal	1	—	—	—	—	—	—	—	—	—	—	—	—	—